RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

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VOL. XXXIX, No. 3. FRIDAY, JULY 21, 1905.

A monthly business meeting of officers and employees has been a feature of the service on the Bessemer & Lake Erie for several months past, and Superintendent Matson informs us that it has been both an interesting and a profitable feature. We call this meeting a "business" meeting because personal matters and grievances are excluded, and because it really promotes the smooth conduct of the business of the road; but General Manager Utley, in his circular announcing the scheme, calls the meeting just a conference for "exchanging ideas." However, the name is not essential. Mr. Utley's circular says:

> In order that the employees of the several departments may come into closer touch with the heads of those departments, for the purpose of exchanging ideas and making recommendations for the good of the service, and for the purpose of having rules and regulations interpreted, it has been arranged to hold a session of the heads of the departments, or their representatives, and the employees at Albion, Greenville, Butler Transfer, or North Bessemer, as may be decided upon from time to time, on the second Monday of each month. Time and place of meeting to be announced by the Superintendent by bulletin. Employees in any branch of the service, who can be spared from their regular duties or who can conveniently arrange to be present, are invited to attend these meetings, and present for discussion, or interpretation, any question pertaining to the good of the service. No personal matters or grievances will be presented at such meetings.

This must be an excellent thing, and it ought to be imitated. It has been said over and over again that the defects in the railroad personnel of this country are due in large measure to the growth of companies—to the fact that the employer is such a big concern that anything but the coldest connection between employer and employee is out of the question. Conferences like those here spoken of will do as much as any one thing to neutralize this evil. Schools established simply for instructing the men on the rules are likely to be too formal. Unless the instructor is an exceptionally good one—and a pleasant fellow besides—they may fall far short of the agreeable interview that they ought to be. Often, too little time is allowed for a given lesson at the school, leaving the result unsatisfactory on that account; voluntary conferences like those on the B. & L. E. should in large measure overcome this defect. The Chicago & North-Western has somewhat similar meetings of station agents. Provided only there is some one man at the head who sees that the subjects are not allowed to become weak and uninteresting and maintains a properly dignified atmosphere, almost any scheme of this kind is useful; for it helps to promote friendly acquaintance. A fair degree of acquaintance is necessary to the *esprit de corps* which is a necessary characteristic of efficient service.

Frequent informal conferences between superintendents, trainmasters, despatchers and road foremen, on one side, and conductors, enginemen and other trainmen on the other side can be made to relieve tension at other meetings. Recently the officers of the New Haven road intimated that committees of employees were a trifle too voluble—came too often and talked too much; such "grievers" ought to be allowed an opportunity to air their views at less formal conferences, and thus pave the way for prompt settlement of differences when they come before the higher officers. If they do not embrace the opportunity to talk to the superintendent, the general manager thereafter may fairly refuse to give up whole days, or even half days, to listening to their wishes or demands. And why should not informal conferences be brightened with pleasanter things than fault finding or difficulties? On the Southern Pacific not long ago the time for a certain grievance committee to send its "boss grievers" to the general officers came around, and there was nothing to grieve about; so they called on the proper officer and told him so; making an oasis in a dreary desert. In railroad life as in social life it is entirely allowable to compliment people before they are dead, if we take care to maintain truth and dignity, and see that our spokesmen are persons of good taste and sound judgment. A thoroughly conscientious and capable superintendent finds it necessary every now and then to spend an hour or two in giving friendly—but perhaps severe—admonition to an old employee who is well meaning but uses bad judgment too often. With proper care and with slight modification such private lectures may be made useful for others, and the hour made more profitable—by being combined, in part, with a conference like those on the B. & L. E. Last but not least, how profitable for themselves, personally, the officers of a division can make such a conference! An experienced retired trainmaster observed recently that not one trainmaster in twenty was well fitted for his position. Without stopping to question the accuracy of this ratio, it is perfectly safe for any trainmaster to assume that he is one of the 19; and as one of the most desirable accomplishments in a trainmaster is diplomatic ability—ability to discuss matters with his subordinates with skill, knowledge and all necessary affability and patience, what better experience can such an officer have than a monthly interview with 20, 50 or a 100 men, half of them armed with questions to test his powers?

THE COST OF MAINTAINING STEEL AND WOODEN CARS.

The plan that has been inaugurated by Mr. Kruttschnitt, of the Harriman Lines, to secure accurate data covering the relative cost of maintenance of their cars of steel construction as compared with all-wood cars promises to yield some interesting and valuable in-

formation. Although the record does not yet extend over a sufficient period to yield conclusive results, the figures already obtained are instructive and are indicative of what the final statement will show. The comparatively large number of cars involved, covering practically all important types, and the wide territory and large mileage represented, afford practically all of the conditions to be met with in service by equipment of this sort. The yearly cost of repairs to the steel construction cars, based on the monthly average for the six months covered by the statement printed elsewhere, is $24, and that of the wooden cars is $38. Some previous comparative figures of this nature, said to be based on returns from a number of different roads, place the cost of repairs to wooden cars at from $35 to $80, and for steel and steel-underframe cars at from $9 to $15 per car per year. (*Railroad Gazette*, Nov 25, 1904.) These latter figures were said to include steel cars that had been in service for six or seven years, and therefore were among the first steel cars of modern design to be built. While not questioning the correctness of the figures given, it was pointed out in our comments at the time that the figures for wooden cars were high, while those for steel cars were undoubtedly too conservative and could not fairly be used as a basis for comparison with the wooden cars because of the relatively short time even the oldest of the steel cars had been in service. It is, therefore, interesting to note that while the cost of repairing wooden cars on the Harriman Lines is close to the minimum quoted above, the steel cars are costing just double the average of the previous figures for this work. Nor is this higher figure in the present instance due to inadequate repair facilities, for, as is well known, the principal shop plants of the several lines composing the Harriman system are modern and of ample size properly to maintain the equipment. We understand that these roads consider themselves practically as well-equipped to care for their steel-construction cars as for their wooden cars. Furthermore, the steel and steel-underframe cars are of a sort that contain few parts that have to be supplied by the builders, and there is therefore no added cost from that source. The figure that they obtain, based, as it is, on careful records, certainly seems more reasonable and more nearly representative of general conditions and acceptable for comparative purposes, than one only half as large.

In analyzing the costs of car repairs on the Harriman Lines, the general conditions which enter as factors should be borne in mind. It is a rule on these roads to keep the high capacity cars in long haul service as much as possible in order to derive the greatest possible degree of benefit therefrom. This doubtless contributes to a lessening of abuse of them in service and also should largely, if not entirely, avoid the coupling of high-capacity cars and the smaller and weaker cars into one train, all of which must have its effect on the repair bills. The amount of repairs made to Harriman Lines cars by foreign lines is undoubtedly much less proportionately than for an eastern road or system having an equal number of cars. This likewise should have a favorable effect on the repair account, particularly for the steel cars, as in the absence of a M. C. B. schedule of repair prices, foreign repairs to steel cars are undoubtedly more costly than home repairs if the facilities in the latter case are at all adequate.

The record will not be complete until it includes an appreciable percentage of wreck repairs, which will, of course, show up to the advantage of the steel-construction and the corresponding disadvantage of the wooden cars.

OUTLYING SWITCHES AND SIGNALING STANDARDS.

The Committee Report on Signal Standards, which was published last spring by the Maintenance-of-Way Association (*Railroad Gazette*, April 7), has elicited no comment, so far as we have observed, except that which was printed in these columns; and for the reason, no doubt, which applies in many a similar case, that declarations which are perfectly sound leave nothing for the commentator to say. But although this committee spoke wisely on the points that it dealt with it left other points untouched; and one of these, the question of the proper protection of isolated facing point switches, is a live one in many places. The signal engineer or chief engineer who wishes to do for himself what the committee has left undone, in the way of establishing standards, may well begin with this feature; or if he is sure that his practice is right already, he ought to try to promote its acceptance by other roads, for at present we seem to be tending toward an undesirable diversity. Many such switches are not protected at all. Of those we are not speaking. If the Mentor wreck and other less startling warnings of the same kind do not afford all necessary admonition on that point, it is difficult to imagine what would or could be effective. Some railroad officers, indeed, seem to deem a common switch stand a switch "protection." The next stage of enlightenment leads them to put up a common switch stand 20 ft. high, and be satisfied with that. In the third stage there is a signal some distance away, but the amount of the distance is not carefully considered, and there is uncertainty as to what the signal (when adverse) indicates to the approaching engineman; and so on, with variations. One prominent variation is the use of a semaphore at the switch in place of the usual switch stand. This arrangement was vigorously denounced by Mr. Ames in a letter which we published last December (page 640). Its undesirability is in some respects quite obvious. Admitting, as we must, that when an engineman enters the side track past such a signal he is passing a stop signal, our only reasonable refuge is to claim that the hand motion which directs him to proceed, takes the place of an indication by the second or dwarf semaphore arm which should be there, but is not. This is going back to a practice common in England twenty years ago. Even if we go to the expense of adding this second arm we still have the inconsistency of not having the post at what is usually the declared fouling point—45 ft. to 100 ft. back of the point.

In deciding on the character or location of a signal, whether for an isolated switch or for any other use, we shall do well to stick closely to simple and fundamental principles. This is not only easiest and pleasantest, but also doubtless the most successful course. Compromise with wrong principles has afforded nobody any satisfaction in the past, and it is not likely that it can afford satisfaction now. One of the first principles is that if any fast trains are run there must be a distant signal. And if real safety is what is desired—regardless of tradition—the term "fast" must be interpreted strictly. Any train approaching a switch too fast to be stopped in season if the switch is wrong, is a fast train as far as that switch is concerned. Thus if provision is to be made for running at full speed when the view is shortened by fog, there is no escape from the requirement of a distant signal at every facing point switch—which on single track means every switch. The alternative is to require enginemen to slacken speed at facing points in times of fog, a requirement which it is exceedingly hard to enforce. In practice we have in the past put this requirement in the rule books, more or less blindly worded, and then have trusted to luck. This requirement really has nothing to do with the number of trains run each day or the profit made from the passengers. If there is only one fast train a day, and it is run, not to meet a public need but only to get a few through passengers away from a rival line, still it demands protection. Safety and rivalry are often incompatible. If you have not the facilities to carry passengers safely you are making false pretenses when you bid for their patronage.

A very useful principle that we ought to adopt at outlying switches is that of height. For fast running we may reasonably employ three heights: 24 ft. for semaphores, with full interlocking and complete signaling; 3 ft. or less for dwarf signals and stands for trailing points (if any stand is used at such switches), and about 8 ft. or 10 ft. for facing point stands. To put this latter 20 ft. high is making a radical change and a considerable expenditure for a very small return. We give the runner a longer view in clear weather, yet help him none at all in foggy weather when he most needs help. By having a difference of 10 ft. or more in height between the switch stand and the semaphore we provide a simple and convenient guide by which to differentiate them quickly.

A principle which is not fully utilized is that of transverse position or distance from the track. It is used in bracket signals, but this use at night is often imperfect by reason of the poor quality of the blue light used on dummy posts. This principle is not an essential in designing protection for an isolated switch, but we mention it because of its simplicity. Two lights, or two targets or disks, side by side, make a distinctive signal, which is reasonably simple and inexpensive. The idea will not be attractive to signal engineers who have to spend their nights and days in reducing expenses to the last degree; but scientific simplicity is likely always to be at variance with that class of economists.

A fourth principle is consistency between night and day signaling. At night we can give three indications by color. By daylight we can give three shape indications (usually called position indications) to correspond with the three night indications. The principle of height and that of transverse situation (as related to the track) have about the same effect in the day as in the night. What advantage do we gain by giving any more information in the day time than in the

night? Practically no advantage, except to new men learning the road; and that is not a feature of much importance. This being so, the principles which we have recounted are not only the most fundamental ones of the matter in hand, but are the only ones that need be carefully considered.

Bearing in mind our first-mentioned principle, that a distant signal is an essential adjunct to any signal (or any danger-point indication, such as a facing point switch or switch target or light) if trains are to be run fast, we have a simple solution of the isolated switch problem; for a corollary of the distant signal principle is the principle that the distant signal is more important than the home. The distant gives the vital information that the train must stop, while the home gives the less important information *where* to stop. Our isolated switch on a slow road is well equipped if it have a 10-ft. stand. That height answers equally well for a fast road because there it will have a distant signal. A target showing

 for stop, and  for all-clear

is fully adequate for slow speeds, and for high speeds is made adequate by the aid of the distant. Thus we conform to the semaphore principle of visibility and to our conventional use of the semaphore (horizontal for stop and vertical for proceed); while still maintaining a difference from the semaphore helping to emphasize the difference in function. This difference in function cannot be done away with; the switch stand only indicates the position of switch rails, while the semaphore indicates stop or go ahead. Our 10-ft. day signal might indeed be a semaphore, and with it we should have as good a distinction from the interlocked semaphore as we have at night; but the oblong rectangular disks fixed, at right angles to each other, on a vertical rod, turning on its axis, have the advantages of cheapness and of adherence to past practice. There is no reason why we should not retain these advantages. The only advantage in using the semaphore in place of them is to make the day indication as poor as the night indication, for no other reason than to secure a useless theoretical consistency.

June Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of June, printed in another co.umn, contains accounts of 18 collisions, 35 derailments, and three other accidents. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

		Killed.	Injured.
1st	Stillwater Junction, Ohio	2	0
6th	Pewamo, Mich.	7	0
7th	Colfax, Wis.	7	0
8th	Davison, Mich.	1	10
13th	Golden Gate, Ill.	2	10
16th	Wilcox, Pa.	2	3
16th	Birmingham, Ala.	0	14
17th	Patapsco, Md.	26	20
20th	Newington, Conn.	3	1
21st	Mentor, Ohio	19	15
26th	Vine Grove, Ky.	3	12

The wreck at Mentor, Ohio, is, no doubt, fairly well fixed in the memory of everybody in the United States who reads the newspapers, and it has taken its place in railroad history as a notable disaster; and yet here in the very same month we have another wreck which caused a third more deaths and which 99 per cent. of the aforesaid newspaper readers have probably already forgotten; if indeed they ever read of it; or read with sufficient care to remember the fact more than a half day. Truly, those Europeans who say that we are heedless and are not troubled about these defects in American railroad service, can not be blamed for coming to that conclusion. How could any one reason them out of it? Patapsco and Mentor combined are responsible for 45 fatalities, but the Government report of collisions and derailments will probably show as many more from other accidents of that class in June. Our own list of only eleven accidents (preceding this paragraph) shows 27 other fatalities, making 72 in all, in this list.

How the Mentor switch came to be misplaced on the night of June 21 is still unexplained. The coroner of Lake county, the coroner of Cuyahoga county, and the State Railroad Commissioner have yet to give the public a report of their inquiries.

The cause of the Patapsco collision is all too familiar; eight men killed on those two freight engines, all of them, presumably, responsible for knowing that they were running on the time of the passenger train! The other nine accidents in the list are notable by reason of circumstances which appear in the record and call for no special comment in this place.

The number of electric car accidents reported in the newspapers in the month of June was 24, in which four persons were killed and 139 were injured.

International Mercantile Marine.

According to the statement just issued, during the year ended Dec. 31, 1904, the company lost $1,750,848 in gross (voyage) earnings, $2,190,427 in total earnings, and $2,194,115 in net earnings. This made a deficit for the year of $2,039,150 against a surplus of $355,295 in 1904. Total gross earnings for 1904 were $27,926,908, and net earnings $1,806,407. Net earnings in 1903 were $4,000,522. The figures for deficit and surplus do not, however, take into account the surplus insurance account, which reduced the deficit for the past year to $1,142,098 and increased the surplus for the preceding year to $1,797,797. The poor showing for the year is attributed to the steamship rate war and the resulting depression in freight rates during the latter part of 1904, and also to the fact that grain crops in the United States were not large enough to provide much export business in grain. The company carried to and from all European and American ports 26.51 per cent. of the total passenger traffic. The report seems especially discouraging from the fact that no allowance appears to have been made for depreciation, for which certainly not less than 5 per cent. annually should be allowed in the steamship business. The company's poor balance for the year is thus really understated. The Cunard Line has also recently made a very unsatisfactory showing for the year, while the German lines have had, on the whole, a very prosperous year. The President of the Mercantile Marine Company states that the outlook for 1905 is more favorable, the forecast of earnings for the first six months showing a large gain over the corresponding periods in both 1903 and 1904.

Dr. C. D. Goodrich, the oculist for the Lake Shore Railroad, will next week make a series of vision tests on the passenger engines over that road, the purpose being to ascertain just how acute the vision of engineers ought to be. He will begin with the slower runs and end with the runs on the fast trains, and then determine on a standard test for vision. The tests are made at the request of the Brotherhood of Locomotive Engineers and with the approval of the Lake Shore officials. The test now required of the engineers is a very rigid one and they are insisting that it should be modified. It requires a practically perfect or "twenty-twentieths" vision without the aid of glasses. The engineers already have obtained a number of concessions along this line but they are demanding more.

The foregoing item comes from Indiana, the state whose Legislature once on a time, it was rumored, passed a law fixing the ratio of the diameter of the circle to its circumference as 1 to 3.20; the purpose being, we suppose, to ameliorate the tasks of the Hoosier school boy. The purpose of the Brotherhood of Locomotive Engineers in the present instance is, no doubt, equally laudable; to make it as easy for a partially blind man as for one with perfect eyes to draw money from the pay car every month. But the present effort will, or ought to be, as futile as the other. The only eyes suitable for a locomotive runner are perfectly normal eyes. To "determine on a standard test" at this date would be like redetermining to have round wheels, straight cylinders and resilient springs in the locomotives. That the oculist goes through this performance at the "request" of the Brotherhood may be readily believed, for the Brotherhood—presumably, we charitably assume, to please a few unreasonable members—has many times before asked railroads to try to set aside natural laws. That the officers of the road approve, is also credible, for officers have to approve all sorts of foolishness to keep the peace with narrow minded employees who "insist" that the company shall take risks with fast trains for the purpose of keeping unfit runners on the engines. If a superintendent is determined to tolerate a runner with defective vision, there is no unsurmountable obstacle in his way, except in states where there is a statute on the subject and a prosecuting attorney endowed with the unusual degree of vigor necessary to enforce such a statute; but there is no reason why the superintendent should try to deceive himself into the belief that he can safely weaken his standard. The standard remains immovable, howsoever much we violate it.

NEW PUBLICATIONS.

Constitution of Hydraulic Mortars. By Henri Le Chatelier; translated by Joseph Lathrop Mack. New York: McGraw Publishing Co.

This book is a translation of the thesis prepared by M. Le Chatelier in 1887 for the degree of Doctor of Science, and has served ever since as the starting point for numerous studies on the subject. It is divided into three parts, in which are successively taken up

Plaster, The Silicates of Barium and Cements and Hydraulic Limes. The chief object of the work is the study of the chemical reactions which are produced in the limes and hydraulic cements either during their calcination or their hardening. Starting with plaster and the silicates of barium as presenting less difficulty in solution and study, a brief historical sketch is given of the work of previous investigators such as Lavoisier, Berthier and Payne, followed by the researches of the author on the calcination and set of plaster, in which the chemical reactions as well as the physical peculiarities of the material are carefully studied. The same method is followed in the other two parts of the book, the third being by far the longest of the three. The whole study of the cements is based upon the idea that all of the phenomena which reside in those bodies are of a purely chemical character, by the thorough understanding of which it should be possible to formulate a theory of the hardening of the hydraulic mortars that would be definite and distinct. In conclusion it is shown that a cement of good quality has a perfectly definite composition and the reciprocal should be assumed. In the elaboration of the chemical reactions, and the suggestions as to the action and manipulation of cements the book cannot fail to be of great value to those manufacturers and engineers to whom the original French has not been accessible.

Osborn's Tables, Fifth Edition; Osborn Engineering Co., Cleveland, Ohio.

This publication is an engineer's handbook containing tables of the moments of inertia and radius of gyration of various forms of girders and columns built up of plates and angles, as well as the working strength of steel and timber columns. In addition to these there are a number of other tables, among them one of square roots, of reactions, shearing stress and bending moments of bridges; of weights of standard railroad bridges; of Cooper's standard loading; various impact formulæ; the moments of inertia and section moduli for various standard and usual sections; concluding with a list of some of the longest bridges of the world.

The tables are arranged for quick and ready reference. Taking those on bridge stresses as an example, they are based on the assumption of a special panel load and panel length of unity, so that actual shear and stresses can be obtained by multiplying the actual panel load by the tabular shear, etc. In this way the table is applicable to any system of measurement whether British or metric.

Suitable explanations accompany all of the tables to make them perfectly clear, thus making the book available for instant use without prolonged study and investigation as to the sources and methods by which the data are obtained.

TRADE CATALOGUES.

Exhaust Fans.—Catalogue No. 180 of the American Blower Co., Detroit, Mich., is entitled Exhaust Fans. It describes the "A B C" fans intended for the removal and conveying of shavings and dust, elevating and distributing of cotton and wool, removal of smoke and fumes, and for use in connection with special heating and drying plants. The book has 66 pages and covers the subject fully both by illustration and text. An eight-page pamphlet accompanying the catalogue is devoted to "A B C" electric disc fans, illustrating and describing different types and showing them driven by different makes of motors.

Atlanta Terminal Station.—The Southern Railway has issued a handsome souvenir showing views of the new terminal passenger station at Atlanta, Ga., which it shares jointly with the Central of Georgia and the Atlanta & West Point. The station was formally opened for use on May 14 last, and is perhaps the handsomest and most commodious station in the south.

Frogs, Switches, Crossings, Etc.—The Weir Frog Co., Cincinnati, Ohio, sends its catalogue No. 7. This is handsomely bound in red cloth and contains upwards of 375 5 in. x 8 in. pages. In it is described and illustrated numerous designs of frogs, switches and crossings made by the company, as well as switch stands, switch fixtures, rail braces, etc.

Air Lift Pumping.—The Ingersoll-Sergeant Drill Co., New York, sends a neat little pamphlet descriptive of its air-lift pump. This is a device for lifting water from wells by compressed air. It operates without shock, jar or noise, and it is claimed that more water can be lifted from a given well by this system than by any other method of pumping.

Steam Specialties.—The Schaeffer & Budenberg Mfg. Co., New York, sends its April catalogue of steam specialties and automobile, brewery and distillery supplies, comprising a full line of valves, gages, counters, whistles, small pumps, indicators, lubricators, etc.

Steam Packings.—The Crandall Packing Co., Palmyra, N. Y., sends its catalogue and price list of its improved steam, ammonia and hydraulic packings. Illustrations and descriptions are given of the various forms of packing made by this company, including "Reinforced" ring and sectional packing, waterproof hydraulic packing, "Helo's" locomotive throttle steam ring packing and asbestos metalic sheet packing.

Paints and Roofing.—The Standard Paint Co., New York, sends its June issue of *The Exchange*. The contents of this issue are devoted to describing Ruberoid colored roofings and floorings and Flexite metal preservative paints.

Car Lighting.—The Consolidated Railway Electric Lighting & Equipment Co., New York, sends its bulletin No. 1, which illustrates and describes in detail the "Axle-Light" system of car lighting.

Motor for Turntables.—The Case Mfg. Co., Columbus, Ohio, sends a nicely illustrated folder descriptive of its "electric mule" for locomotive turntables.

Rail Benders.—Bulletin 14 of the Buda Foundry & Mfg. Co., Chicago, is devoted to rail benders, including "Jim Crow" and roller styles.

CONTRIBUTIONS

Treated Ties.

Nice, France, May 16, 1905.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Prof. Dr. Hermann von Schrenk in his article published in your issue of May 5, says (page 422): "There is a tendency towards not only using preservatives, but preservatives of a better grade than have hitherto been employed. This is showing itself in the consideration of processes which use a combination of zinc chloride and creosote."

The results of good and bad work in using zinc or creosote, or zinc and creosote, are sufficiently known in the United States and in Europe; but the difference in opinion as to choosing the best of these methods is the same as heretofore. Both of these preservatives give excellent results as long as they are not washed out. It would certainly not answer the purpose to reduce the quantity of zinc and it remains somewhat doubtful whether reducing the quantity of creosote will or will not do. On the other hand, it is a well-known fact that sulphate of iron is not only a good but by far the cheapest preservative. The quantity of ties used in the United States and their proportionally low price require a cheap treatment and a large turnout per cylinder. The only means tested up to date in the United States for the purpose of keeping sulphate of iron in the timber is the Hasselmann system. It does not, of course, protect rotten ties (Texas test track), but it keeps ties from rotting, provided they are impregrated to the very core.

A temperature of 130 deg. to 140 deg. Celsius tends to destroy the fiber of some kinds of timber, and free sulphuric acid destroys them all. The problem therefore consists in considerably reducing the temperature, at the same time securing thorough impregnation and absolutely preventing the deleterious formation of free sulphuric acid. How this is done is apparently not known to Prof. Dr. von Schrenk, but it will be made known to him in case he is inclined to take up the discussion *coram publico* by answering the question: Why the testing of the Hasselmann system in the United States does not justify its consideration as well as for instance the Rüping process?

MAX BARSCHALL.

Failure of a Concrete Sea-Wall.

BY GEORGE W. BLODGETT, C.E.

Point Allerton, in the town of Hull, Mass., is a promontory or headland about 150 ft. high situated at the north end of Nantasket Beach, which is about three miles long. The hill at Point Allerton is composed of gravelly clay containing numerous bowlders and is joined by a narrow strip of beach of coarse gravel to a somewhat similar headland a mile away to the southwest, on which the village of Hull is built. This isthmus is scarcely more than 100 ft. wide for a considerable distance, and on it are built the county road and the Nantasket Beach branch of the New York, New Haven & Hartford, by means of which Hull is connected with the main land at Hingham and Cohasset, five miles away.

The great storm in November, 1899, which caused destruction of life and property along the New England coast, nearly washed away this narrow strip of land which divides Boston harbor from Hull bay and which is exposed to heavy seas from the north. Had the sea broken through, it would have converted the end of the peninsula into an island and destroyed the fine achorage in the bay where yachts and small boats are usually moored in perfect safety, no matter how heavy the seas may run outside. To prevent

further damage, the State of Massachusetts soon after built a breakwater of Portland cement concrete on the harbor side. This breakwater is about 1,450 ft. long and was built in sections by building a mould of boards and timber and ramming the concrete in place. It is greatly strengthened and the stability of the beach in front largely increased by a series of 12 wing walls 110 ft. apart extending out towards the sea about 50 ft. and sloping down to the water level at a slightly greater angle than the beach. A general view of the breakwater and the wing walls is shown in Fig. 1.

The main wall or breakwater is 3 ft. wide at the top with a batter of 2 in. to the foot, and is 6 ft. high at the shallowest point. The wing walls are 2 ft. wide on the top and are practically one piece with the main wall, being joined to it by a curve of 1-ft. radius at the angles; in fact, all of the angles and corners are rounded so as to offer but slight resistance to the waves which sometimes dash to the very top of the wall.

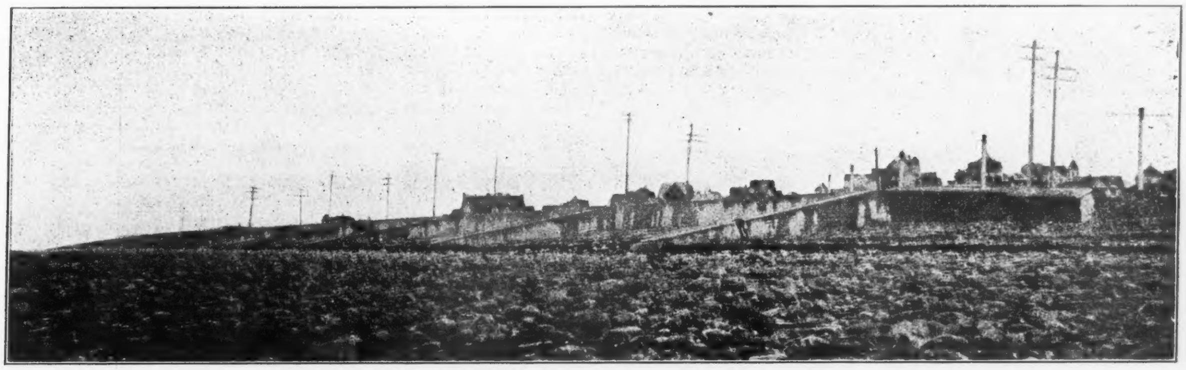


Fig. 1—General View of Sea Wall and Wing Walls at Hull, Mass.

The breakwater extends out 50 ft. beyond the last wing wall on the south end and has been undermined by the heavy waves. It was, therefore, in the condition of a beam supported through most of its length but at the free end acting as a cantilever. The wall, being of concrete without steel reinforcement, had not sufficient tensile strength to support the weight of the overhanging part, which was 16 ft. long, and as a result this much of the wall broke off nearly square across. A second break occurred 31 ft. farther in as the undermining action of the waves continued. This break is of the same general character as the first, but shows more clearly the effect of the longitudinal shearing forces which are well known to exist in beams when broken transversely but which in a material like concrete are not easy to demonstrate. Fig. 2 shows the two breaks and illustrates their different character, and Fig. 3 is a closer view of the second break, which shows the curve of the junction of a wing wall with the main wall. Fig. 2 also shows the appearance of one of the wing walls and the effect of the buffeting it has received on the end next the water from the heavy seas which wash over it during every storm. It is submerged for part of its length at nearly every tide, but only the highest tides with wind from the north or west cause the waves to dash against the breakwater itself with any considerable force. Except for the undermining and the breaks at the outer end the breakwater shows no signs of deterioration. The wing walls are none of them seriously impaired after five years of exposure. They are worn away only at the ends for a short distance, on most of them for not more than 2 or 3 ft., although in one case the top has been broken away to a depth of about 3 in. for a distance of 7 ft.

Fig. 2—View Showing Two Breaks in Main Wall.

At this time it can only be conjectured whether, when the breaks occurred, the end of the wall hung free and unsupported for the whole 16 ft. between the first break and the end of the wall, or whether it was gradually undermined for this distance, bringing more and more tension on the upper layers of concrete until fracture occurred. A rough calculation made on the assumption that the whole weight was unsupported for the whole 16 ft., gave as the approximate tensile stress at the extreme top of the section, 551 lbs. per sq. in. This is not an impossible value for the unit stress at the instant of rupture as tests by the Boston Transit Commission in 1895 1896 gave, according to Trautwine, a maximum value of 531 lbs. per sq. in. in beams 6 in. square of 30 and 60-in. span, tested when from 29 to 37 days old, 24 hours in air and the rest of the time in water. Making the same assumptions regarding the other piece which broke off, would give as the extreme tensile stress 2,083 lbs. per sq. in., which seems much too high although test pieces from the concrete used in the bridge over the Danube at Munderkingen, Germany, broke at from 2,000 to 4,560 lbs. per sq. in., varying with the age of the specimens (which, however, Trautwine does not give).

The writer thinks that it may be supposed with reason that these breaks occurred on account of a violent shock due to a wave of more than usual magnitude and force; which brought a sudden and momentary stress (due to its impact) far greater than the mere weight of the wall itself so that it cannot be positively determined what the actual strength of the concrete was but only that it was not *strong enough* to resist whatever stresses were imposed upon it.

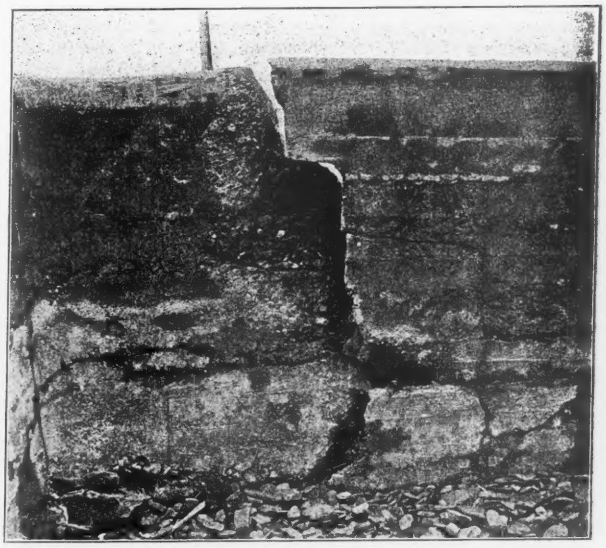


Fig. 3—Appearance of Second Break.

From the perfect state of preservation and the excellent appearance of the rest of the breakwater and the wing walls there is good ground for stating that Portland cement concrete, well made and well laid, will resist the action of the sea under all ordinary conditions if the mass of the masonry is sufficiently large and the masonry is carried deep enough to prevent undermining for any considerable distance. Wing walls, reasonably close together and carried out at right-angles for 50 ft. or more, will prevent any extensive displacement of the material immediately in front of the wall and perhaps altogether remove any danger from undermining in nearly all situations. For the most extreme cases, stone masonry would probably be better, as this material has a crushing strength of from three to twelve times that of concrete.

Comparative Cost of Repairing Steel and Wooden Cars on the Harriman Lines.

In order to determine definitely what it is costing the Harriman Lines to maintain their steel cars and cars of composite construction as compared with all-wood cars, Mr. Julius Kruttschnitt, Director of Maintenance and Operation, last fall arranged to have kept separately the repair accounts of all of the steel cars and an approximately equal number of wooden cars. The cars of steel construction comprise practically all kinds, including gondola, coal, flat, ballast, oil, stock and box. The wooden cars were chosen so as to be comparable in age, capacity and kind to the steel cars, only the newest lots being represented in the list. It was desirable to have the number of wooden cars chosen from each line equal, approximately, the number of steel cars from that line, but this did not work out very well in the case of the Union Pacific and the Oregon Short Line, the latter having only a small number of wooden cars that could be compared fairly with its steel cars. This discrepancy is balanced by the excess in wooden cars for the Union Pacific, which include a lot of 3,000 box cars bought on one order.

HARRIMAN LINES.—COMPARISON OF COST OF REPAIRS OF STEEL AND WOODEN CARS FROM OCTOBER, 1904, TO MARCH, 1905, INCLUSIVE.

	October,		November		December		January		February.		March		6 months.
	No. of cars.	Average cost per car.	No. of cars.	Average cost per car.	No. of cars.	Average cost per car.	No. of cars.	Average cost per car.	No. of cars.	Average cost per car.	No. of cars.	Average cost per car.	Average cost per car.
Steel Cars.													
Union Pacific	2,825	$2.94	2,826	$2.09	2,826	$2,41	2,826	$2.78	2,826	$2.72	2,826	$2.98	$2.65
Oregon Short Line	2,326	1.80	2,326	1.28	2,326	1.62	2,326	1.97	1,326	2.43	2,326	1.92	1.84
Oregon R. R. & Nav.	120	1.64	120	3.69	120	1.40	120	1.25	120	1.01	120	4.32	2.22
Southern Pacific Co.—Pacific System	4,603	1.36	4,637	2.08	4.636	1.63	4,636	1.97	4,634	2.61	4,633	2.40	2.01
Southern Pacific Co.—Atlantic System	1,250	.16	1,250	.40	1,350	.40	1,350	.46	1,350	.53	1,350	.57	.42
Total, all lines	11,124	$1.72	11,159	$1.74	11,258	$1.85	11,258	$1.99	11,256	$2.33	11,255	$2.25	$1.98
Wooden Cars.													
Union Pacific	5,360	$4.44	5,360	$3.57	5,355	$4.02	5,353	$4.15	5,346	$3.75	5,343	$4.45	$4.06
Oregon Short Line	361	4.47	361	2.45	361	2.49	361	2.87	362	2.21	363	4.02	3.08
Oregon R. R. & Nav.	214	1.96	214	1.32	213	3.18	213	1.85	213	1.53	213	1.77	1.93
Southern Pacific Co.—Pacific System	3,966	2.14	3,966	2.40	3.962	2.16	3,959	2.34	3,954	2.74	3,952	2.36	2.36
Southern Pacific Co.—Atlantic System	800	1.10	800	1.65	785	2.18	785	1.76	785	2.02	785	2.30	1.83
Total, all lines	10,701	$3,29	10,701	$2.91	10,676	$3.13	10,671	$3.22	10,660	$3.15	10,656	$3.45	$3.19

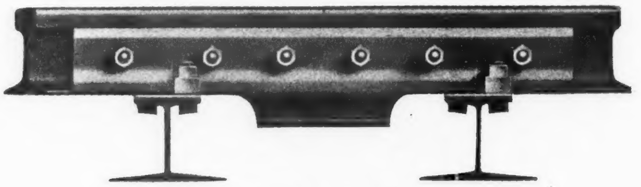
The accompanying table exhibits the record for six months. It shows the number of cars from each line, the average cost per car for each month of the six, both for each line and for all lines, and also the averages for the six months period. It will be seen that the average monthly cost per steel car for all lines for the six months is $1.98, while the corresponding figure for the wooden cars is $3.19, a saving of $1.21, or 38 per cent., in favor of the former.

Considerable variation in the cost of repairs on the different lines will be noted, particularly the high figures for the Union Pacific and the low figures for the Atlantic System of the Southern Pacific. The causes for this are being investigated at the present time at Mr. Kruttschnitt's direction. However, in general the higher costs on the Union Pacific are attributed to the relatively greater age of a considerable proportion of the cars and to the somewhat higher miles run per car. This latter is due to the preponderance of through business on the Union Pacific, which is greater per car than on the other lines. The steel cars of the Union Pacific include a number of coal cars and ballast cars built at a much earlier date than the cars of the other lines with which they are compared. The Atlantic System cars are comparatively new, and most of them are flat cars, which, of course, cost much less for repairs than box cars.

The intention is to continue the record until satisfactorily accurate data on the comparative costs of the two kinds of construction have been secured.

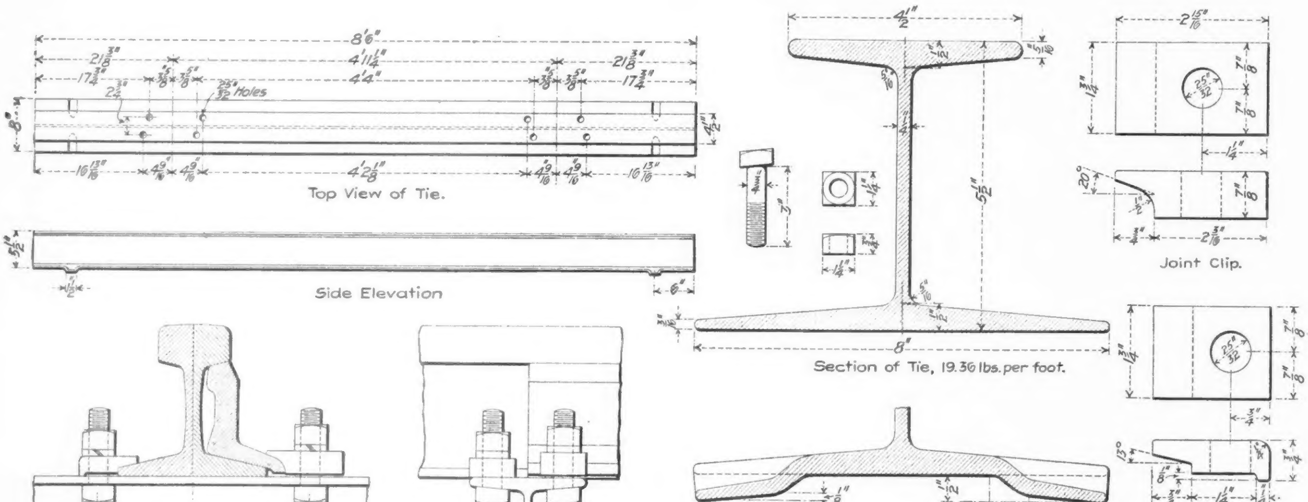
Steel Cross Ties.

The accompanying illustrations show a new steel tie made by the Carnegie Steel Company, Pittsburg, Pa. As shown, the cross section of the tie is a modified form of the well-known I-beam.



Application of the Carnegie Steel Cross Tie.

This section combines ample bearing surface of the proper shape for bedding and tamping; sufficient surface for seating the rail; the greatest rigidity and transverse strength for a given weight of material, and an easy means for securing the rail to the tie. The tie, as shown in the illustrations, has a top flange $4\frac{1}{2}$ in. wide; a bottom flange 8 in. wide; a web $\frac{1}{4}$ in. thick, and a depth of $5\frac{1}{2}$ in. The length over-all is 8 ft. 6 in., and the weight per foot is 19.7 lbs., or a weight of 167.4 lbs. per tie, exclusive of the fasten-



Details of the Carnegie Steel Cross Tie.

ings, which weigh about 6 lbs. The rail is secured to the tie with four ¾ in. bolts, by means of rolled steel clips fitting accurately on the flange of the rail, having a bevel exactly the same as that of the flange and carefully punched so that the shoulder of the clip gives proper and positive rail alinement. The necessary insulation when automatic block signals are in use is provided for by wooden shims placed between the rail and the tie; fiber bushings around the bolts, and fiber washers under the nuts. A number of these ties have been in service for the past two years on lines carrying fast and heavy traffic. The New York Central & Hudson River has them in use near Castleton, N. Y., and they are also in use on the Duluth & Iron Range Railroad and on the Lake Shore & Michigan Southern. The Bessemer & Lake Erie, after a six months' test of one-half a mile of track equipped with these ties, has placed an order for about 2,100 tons of the ties, this being sufficient for the equipment of 10 miles of track.

Locomotives at the Liege Exhibition.

BY C. R. KING.

(*Continued from page 48.*)

The 16-wheel articulated locomotive of the French Nord Railway mentioned in the previous article is well worth a more extended description. The principal original feature in this engine is the central girder frame which supports the boiler and takes all the strains of the train couplings, in this respect differing from most articulated locomotives in which the motor truck takes the pull of the couplings. This is not the case, however, with the Mallet system unless the engine is running with the cab in front. When running on short-radius curves the long boiler and central frame form a tangent with the outside of the curve, and with the ordinary coupling arrangements this lateral displacement would have a strong tendency to derail the car next to the engine. To obviate this difficulty the coupling hook is free to slide from side to side in a wide slot in the bumper beam and the coupling bar is attached far back on the central frame to minimize the lateral pull.

The motor trucks are unaffected by the extreme lateral displacement of the boiler and central frame. The pivot itself is a large hollow spherical casting resting in a cup bearing contained in the heavy cast-steel frame which serves to brace the plate frames of the motor truck. It has no lateral displacement. The pivot is bolted to the under side of the box-girder central frame, which is in turn secured to the heavy smokebox saddle at the front end of the boiler. The truck has thus universal rotation about its pivot. The boiler, which has a high center of gravity, cannot roll for there are outwardly projecting arms on the saddle casting which bear against the upper sides of the pivoted motor truck frame through the intermediary of a buffing spring whose central pin carries a steel roller which turns with the swiveling of the truck.

At the firebox end the boiler is rigidly supported. The mud ring rests directly upon the central frame in the middle, and at the sides it is carried on the usual expansion brackets through the intermediary of side rests which allow the free radial movement of the rear motor truck. Midway between the two end supports of the boiler there are two other supports on the central frame which consist of double metal sheets, allowing as usual for contraction and expansion. The central frame being placed so high up under the boiler necessarily leaves but little room for the ash pan under the full width of the firebox. The ash pan is therefore forked at its front end, and to provide for cleaning without detriment to the axle boxes, etc., on the rear truck, open troughs lead out from the extremities of the side ash pans to drop the ashes clear of the rails.

With the adoption of two instead of one swiveling truck the number of flexible joints required has been augmented. These are (1) the high pressure steam pipe which is carried from the dome to the back end of the boiler (below the foot plate), where the vertical axis of the pipe corresponds with the pivotal axis of the truck—from whence the pipe is led forward to the high-pressure cylinders. (2) The exhaust pipes from the high-pressure cylinders to the low-pressure cylinders. These pipes, which lie in a direct line between the two groups of cylinders, have been made to allow for the aggregate radial movement of the two motor trucks. They consist of sliding sockets with spherical ends similar to the type adopted in the Mallet locomotives for the vertical connection of the low-pressure exhaust with the blast pipe. It remains to be seen if such an arrangement will stand the wear of time and keep tight. (3) The high-pressure steam pipe running from the dome to the low-pressure cylinders for use when it is required to work all cylinders with boiler steam direct. In this case, as the pipe is of small diameter, a short length of steel-braided metallic hose is used without recourse to a swivel joint. (4) The exhaust from the low-pressure cylinders. This consists of two large rubber pipes connecting each low-pressure valve chest pipe with a large Y-pipe at the back of the smokebox. This rubber piping is tightly wired and takes the place of the spherical-joint, sliding pipe of the Mallet system, already referred to. The other flexible connections on the engine are of minor importance. It will be seen that the numerous flexible joints correspond closely to those in the Meyer system, notwithstanding that after competitive trials of the Meyer and Mallet engines on the Saxon railroads the Mallet was selected for its greater practicability.

The lateral pipes between the high-pressure and low-pressure groups are fitted with the de Glehn intercepting valves for making the change from simple working to compound. When the valves open the high-pressure exhaust to the air, the steam thus discharged passes by a short branch pipe cast upon the low-pressure exhaust pipe—this being neatly and simply designed—and as the intercepting valve is immediately behind the low-pressure cylinders no flexible joint is needed.

The water tanks are supported above the plate frames on each side and are divided into two sections, front and back. The forward tank reaches beyond the front of the boiler, but this causes no inconvenience in cleaning the smokebox as pipes are carried through the tank bottom through which the cinders are discharged. Nor do the tanks interfere with the view of the track immediately in front of the engine, as they are of triangular cross-section, which allows a lookout between their sides and the sides of the boiler. The engine is "double ended" in respect to its trucks, so that it can be run equally well with its cab at the front end. The coal bunker behind the foot plate holds five tons of coal, but it allows a clear view from the rear windows of the cab.

The following table gives the principal dimensions of this peculiar locomotive:

Fuel	Bituminous coal
Weight of engine, loaded	224,880 lbs.
Weight of engine, empty	171,960 "
Wheel loads, axles 1, 2, 7 and 8, fully loaded	30,865 "
" " " 3 and 6, fully loaded	33,071 "
" " " 4 and 5, fully loaded	17,639 "
Weight for adhesion, half load coal and water	176,368 "
Co-efficient of adhesion, working simple with full load	4
Co-efficient of adhesion, with full load working compound	5.3
Driving wheels, diameter	57¼ in.
Bearing wheels, diameter	33½ in.
Wheel base of each truck	19 ft.
Wheel base of engine	41 ft. 3½ in.
Length of engine	51 " 7¼ "
Width of engine	9 " 5 "
Height to center of boiler	9 " 2¼ "
Maximum theoretical tractive effort, compound	41,021 lbs.
Maximum theoretical tractive effort, simple	53,052 "
Boiler pressure	228 "
Pressure in receiver pipes	92½ "
Grate area	32.29 sq. ft.
Heating surface, firebox	129.0 "
Heating surface, tubes (Serves)	2,503.30 "
Total heating surface	2,632.30 "
Diameter high pressure cylinders	15¾ in.
Diameter low pressure cylinders	24¾ "
Common stroke of pistons	26¾ "
Capacity of water tanks	3,400 gals.
Capacity of coal bunkers	5 tons.

Superheaters on Belgian Locomotives.

The accompanying drawings show two recent types of superheaters with which a number of the Belgian locomotives at the Exhibition are fitted. Fig. 1 shows the Cockerill system with extended smokebox door, and Figs. 2 and 3 show the details of the latest design of the Schmidt superheater, which is a much simpler arrangement than previous designs of the same inventor. The main feature of both superheaters is the placing of the steam tubes within the fire tubes of the boiler, a number of which are made large enough to receive them. This entails in consequence a loss of evaporative power in the steam generator. The Schmidt device is the simpler of the two, as it is intended solely for single expansion engines, and the only regulating device it requires is a trap door in the smokebox to cut off the passage of hot gases through the upper fire tubes when steam is not circulating in the superheating tubes. The Cockerill superheater is for compound engines and provides for several modifications in the distribution of the heat in the superheating tubes.

In both the Cockerill and Schmidt arrangements, the location of the superheating tubes is a more rational one than in the many superheating systems current on the European continent, for in both of these arrangements the heat is absorbed from the gases in their passage from the firebox to the smokebox instead of as in previous arrangements, the heat being specially carried to the coldest part of the boiler to there perform its work at a serious loss to the thermal efficiency of the whole generator. In the United States the attention of inventors is now particularly concentrated upon the firebox end of the boiler as the proper location of the superheater, and if a practical and durable device can be put in there it will probably replace the European types of smokebox superheaters by reason of its immense superiority in effectiveness.

The results in economy attained by the use of superheaters on locomotives, when published by interested or even remotely interested parties, have been received with extreme caution by locomotive designers ever since the superheating locomotives introduced on the Chemin de fer du Nord in 1862 by M. Jules Petiet, were abandoned, but they are coming more and more into use and are fully justifying the claims made for them. The Belgian State Railways have applied Schmidt superheaters to 25 locomotives of five

different types. So far, the best results obtained have been from 12 to 13 per cent. saving in coal and 16 to 18 per cent. saving in water, these results confirming those obtained by other systems of superheating employed on the State Railways of Austria and Saxony. With the apparatus applied to new engines, these Schmidt superheaters are said, in some cases, to have required no special attention in 1½ years. Those who have seen locomotives equipped with the old form of Schmidt superheaters lying at the Borsig Locomotive Works at Berlin awaiting repairs will consider this a fine record. This most important question of repairs and the difficulty of repairing those parts only indirectly connected with the superheating apparatus, are items of great importance in the ultimate adoption of superheaters in general locomotive service, and to overcome these difficulties nothing but persevering trials of the best and latest types and the rejection of old types will avail.

The Schmidt superheater of the Belgian State Railways is clearly shown in Figs. 2 and 3. A steam receiving box or collector is placed in the smokebox and from this two 1¼-in. steel tubes run back into each of the three upper rows of 4⅝-in. fire-tubes. A short distance in front of the firebox they are bent back and return to that division of the collector from which the cylinder steam pipes lead. The reheating tubes are protected from the action of the fire at the back end by U-bends of steel castings. The extremities of the tubes at the smokebox end are flared out and the flanges are screwed into the cast-steel receiver or collector. Asbestos is used in packing the joints. Instead of copper, which is the usual practice, the smokebox steam pipes are of iron and the large fire

pay for the additional first cost of the apparatus and its upkeep in serviceable condition remains to be determined. The coal economy is equal to that obtained by compounding which itself costs greatly for maintenance. The heat thrown out of the stack by the exhaust is so great that double stacks have been provided to prevent burning of the metal, and consequently the heat waste is greater than with saturated steam. A desirable economy remains to be effected in extracting more of the heat from the exhaust steam before it leaves the cylinders.

The new Cockerill superheater shown in Fig. 1 has three reheating tubes in one fire tube instead of four as in the Schmidt system, and the three upper rows of the fire tubes are employed for this purpose. The collector boxes are differently placed, however. In the Cockerill device, the reheating tubes extend forward to the point of the smokebox where the collector is located. At the firebox end the fire tubes stop at a receiver box for the steam drawn from the regulator. A number of fittings are provided to enable the steam to be superheated both before and after it enters the high-pressure cylinders, and also to superheat the steam only after it has passed through the high-pressure cylinders, the object being to ascertain by trial which is the most economical method for compound engines before adopting a standard design for compounds.

To make the following explanation clear, reference is made to the diagram, Fig. 1, which shows the superheater as applied to one of the engines at the Exhibition. The throttle at B has three pistons permitting a duplex movement. It allows steam to pass by

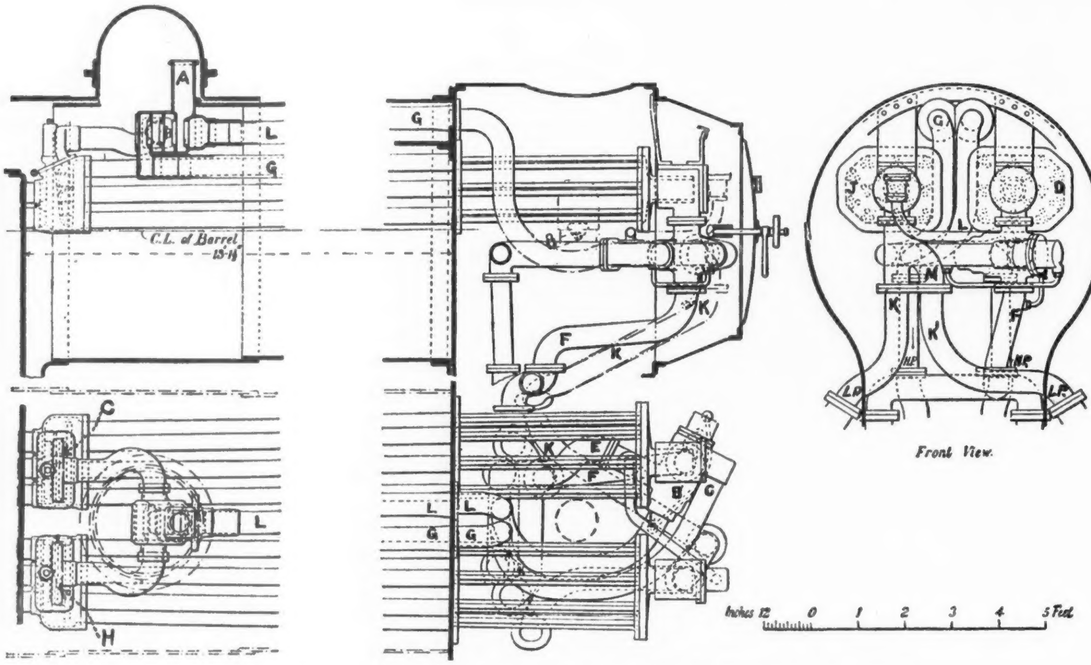


Fig. 1—Details of Cockerill Superheater as Applied to Belgian Locomotives.

tubes holding the reheating tubes are also of iron. These large fire tubes are screwed in the firebox flue sheet and are plugged with iron ferrules, but in the smokebox flue sheet they are expanded as usual. A hinged flap below the collector box serves to cut off the draft through the large fire tubes and also to prevent the ingress of heat from the lower fire tubes when the cylinders are not taking steam. The usual expedients are resorted to to prevent damage where superheated steam is employed. The degree of superheat is shown on a scale in the cab by means of a pyrometer placed in one side of the collector box and a thermometer placed in the other. The piston valve segments, of cast-iron, are three in number, and steam is admitted behind the central or principal segment. The valves and pistons are lubricated with a six-way lubricator actuated by a force pump. Cast-iron or white metal packing rings are used. With the Stephenson valve gear employed, the reversed position required for giving inside admission to the piston valves is effected by the introduction of rocking levers. The piston valve chests are fitted with air suction valves having their orifices placed over cups on the running board to prevent the entrance of foreign matter.

In the first trials made with this form of superheater, two engines exactly alike in all other particulars except the superheater were employed. It was found that moderate superheating resulted in little or no economy, but that superheated temperatures of from 570 deg. Fahr. to 660 deg. Fahr. were essential to obtain the saving previously mentioned; of 12 to 13 per cent. in coal and 16 to 18 per cent. in water. How far the economy in coal will

the pipe L, direct to the high-pressure cylinders or by the pipes C into the superheater receivers at the firebox end of the large flues, the object of the two receivers being to divide the reheating tubes into two groups. The left-hand group reheats the steam in its passage to the high-pressure cylinders. The right-hand group reheats the steam passing from the high-pressure to the low-pressure cylinders. This steam is brought back to the rear end of the tubes by the pipe G, and passes forward through the right-hand group of reheating tubes into the front collector J, then to the pipe K and so into the low pressure valve chest. The steam pipes from the collector D to the high-pressure cylinders pass down through a valve B¹ and the pipe E into the valve chests. Valve B¹ is similar to the throttle valve B, and the movements of the two are connected so that the various changes in the direction of the movement of the steam are governed simultaneously at both ends of the reheating tubes.

When only the exhaust steam from the high-pressure cylinders is to be superheated, the throttle B admits boiler steam to the main dry pipe L from which it passes through valve B¹ and pipes E into the valve chests of the high-pressure cylinders. The exhaust from the high-pressure cylinders passes by the pipes F through the valve B¹ into the collector D, thence back to the firebox end through the left-hand group of reheating tubes and into the receiver on that side. It then passes up the pipe C, through the throttle B and enters the receiver of the right-hand group of tubes. From there it passes forward to the front receiver J, through the pipes K and into the low-pressure valve chests. With

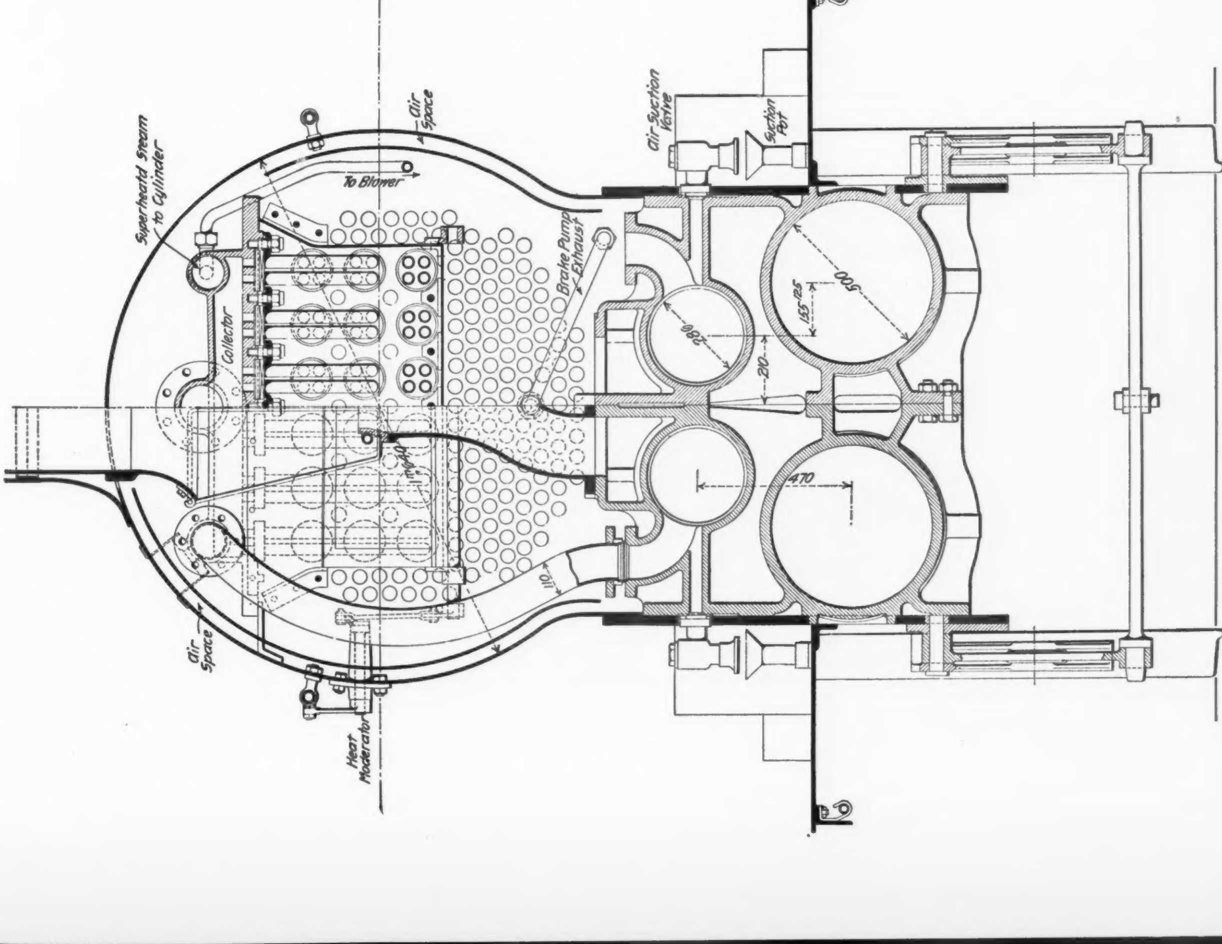


Fig. 2—Section Through Cylinders and Smoke Box of Belgian Locomotive Equipped with Latest Type of Schmidt Superheater.

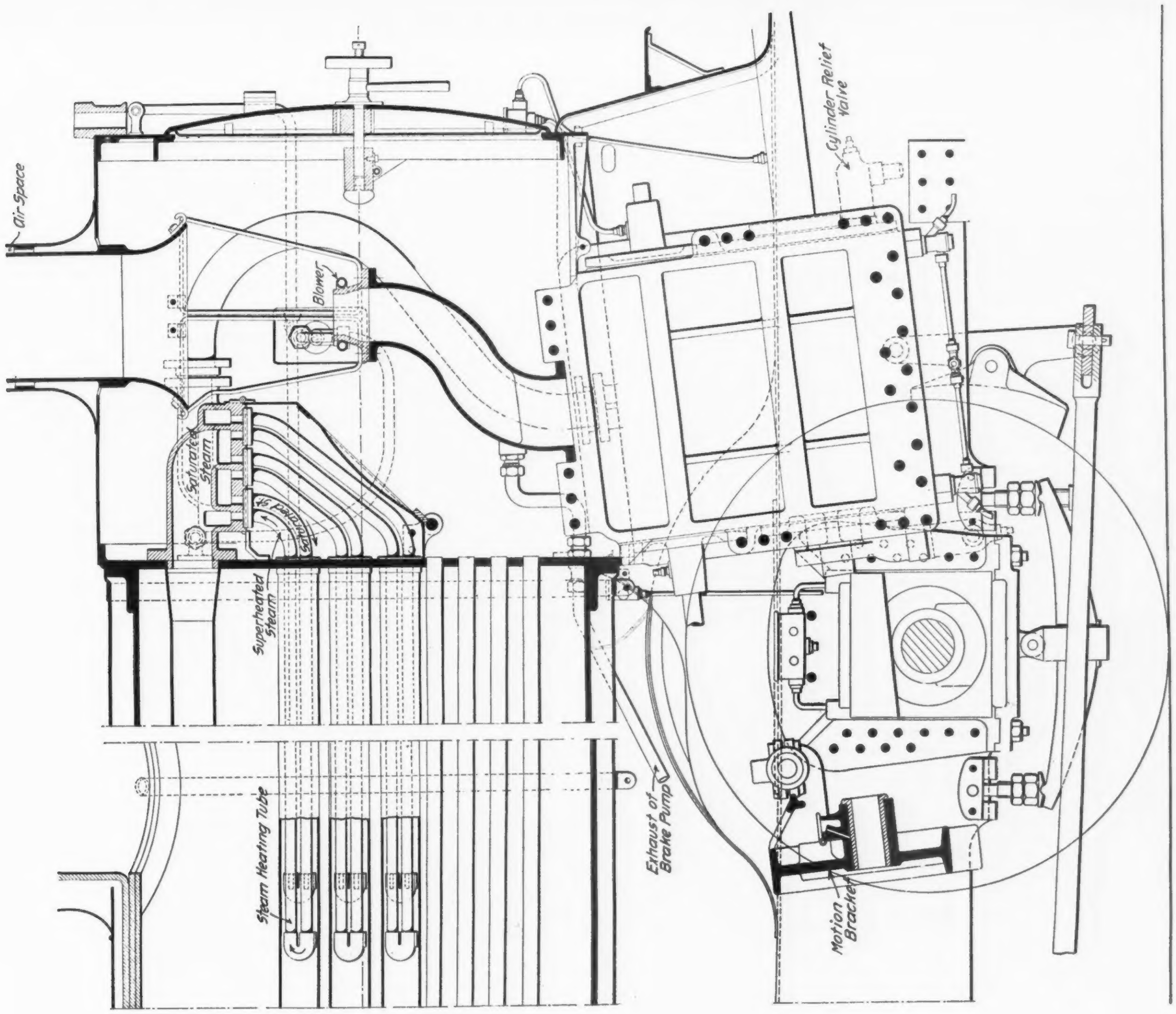


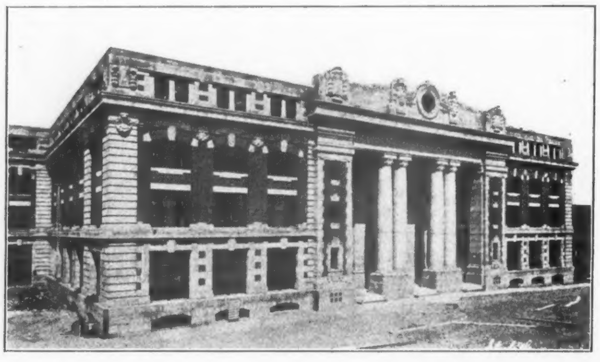
Fig. 3—Longitudinal Section Through Smoke Box of Belgian Locomotive Equipped with Latest Type of Schmidt Superheater.

saturated steam such a tortuous passage would result in excessive wire-drawing, but with superheated steam this need not be taken into account. A number of accessory arrangements are indicated on the drawing, the object of which is to facilitate the movement of the steam through the apparatus, and they need not be described here. The following table gives some of the principal dimensions of the Belgian State Railway engines fitted with superheaters which form a part of the Exhibition:

Type	0-6-0	4-4-0	4-6-0
Simple or compound	Simple.	Simple.	Compound.
Service	Freight.	Passenger.	Exprs-Passengr.
Builder	St. Leonard.	Haine St. Pierre.	Cockerill.
Cylinders, diameter	21.65 in.	19.68 in.	14.17 & 24.41 in.
Piston, stroke	26.0 "	26.0 "	26.77 in.
Diameter of drivers	59.84 "	77.95 "	70.87 "
Boiler pressure	....	191 lbs.	228 lbs.
Heating surface, tubes	....	967.68 sq. ft.	1,696.40 sq. ft.
" " firebox	....	131.31 "	196.98 "
" " total	....	1,098.99 "	1,893.38 "
Grate area	....	21.6 "	32.29 "

Canadian Pacific Improvements at Winnipeg.

The Canadian Pacific yard, shop and terminal improvements at Winnipeg, Man., were described in these columns a year ago. (*Railroad Gazette*, June 24, 1904). The work has now been completed, with the exception of the hotel being built in combination with the passenger station. When completed this hotel will be the largest



Main Entrance to Waiting Room, Winnipeg Station.

in Canada, with 315 guest chambers, 14 ft. x 16 ft., and 63 bedrooms for the staff. Of the 315 guest rooms, 175 have bath rooms attached, and can be divided off into suites. The hotel has a ground area of 236 ft. x 190 ft. and is eight stories high. The ground floor, which is finished with marble tile and carved wood, is occupied by a large rotunda and reception, dining and service facilities. The main entrance is from Fonseca avenue, with a rear entrance from the train-shed of the station. The first floor contains, in addition to the bed rooms, the drawing, palm and breakfast rooms, together with a vice-regal suite. The other floors are occupied by bed rooms with bath and other accommodations. The help's quarters for the hotel are in the rear facing the railroad tracks and

Main Street Subway and Viaduct.

are carried up two stories above the ground floor. The building is of fireproof construction throughout, the Roebling system of concrete floors being used with terra-cotta partitions and furring. On account of the character of the clay it was found necessary to build the hotel on a pile foundation, whereas this clay was considered sufficiently solid to carry the station building, which is only half the height. There are 1,500 piles in the hotel foundations. The total cost of the building will be about $750,000.

The hotel and station cover an area of 84,000 sq. ft., the station being 171 ft. x 136 ft. and the express and baggage rooms 54 ft. x 300 ft. The station is four stories high and is of steel and brick construction. The ground floor has a main waiting room 94 ft. x 102 ft., with a large vestibule and portico entrance, also a ladies' waiting room, 38 ft. x 43 ft., with retiring and lavatory accommodations. There are cafe, lunch and smoking rooms, and telegraph and telephone facilities. The basement under the express and baggage rooms contains storage rooms. The three upper stories of the building are divided up into offices, which are occupied by the general staff of the Western Lines. The building rests on concrete footings thorughout and the foundation walls are of rubble masonry. The basement walls are furred with terra cotta and the exterior finish is of cut stone and pressed red brick laid in cement mortar. The station cost approximately $450,000. The contractors for it and the hotel were P. Lyall & Sons, Montreal.

The buildings are steam heated by the Webster system, supplied from a 800 h.p. battery of Babcock & Wilcox boilers. Electric light and power are supplied by four 75 h.p. simple engines and four compound-wound 75 k.w., direct-current, 250-volt generators. All wiring is run in iron conduits. Telephone connection and electric fire bells of the continuous ringing type are installed throughout. There are three direct-connected electric passenger elevators, two for the hotel and one for the station. There is also an electric baggage hoist for the hotel and hydraulic elevators in the baggage, express and boiler rooms.

The Main street subway was described and illustrated in detail in the previous article. A view of the finished viaduct is shown herewith. It is a reinforced-concrete groined-arch structure 100 ft. wide east and west over sidewalks, 140 ft. north to south, and carries eight tracks. There are three main elliptical arches over the roadways and two semi-circular arches over the sidewalks carried on four rows of reinforced concrete columns and two abutments. The central span is occupied by street railway tracks, the other two large spans being used as driveways. The street has a grade of 1 in 20 and is paved with cedar blocks. The sidewalks and retaining walls are of concrete. One-half of this structure was completed and carried the railroad tracks before the other half was started, and being located so close to the station and on the main thoroughfare of the city, required that both vehicular and railroad traffic be provided for continuously. There were 24,000 cu. yds.

General Waiting Room, C. P. R., Winnipeg Station.

of excavation, and 16,000 ft. of piling to support the 4,900 cu. yds. of concrete. The structure is reinforced with 315 tons of structural steel and steel rails. There are a number of skylights to light the subway, as well as electric lights for night use. The cost was approximately $190,000. Deeks & Deeks, Chicago, were the contractors.

The freight sheds and roundhouse were described and illustrated in the former article, which also gave a plan of the entire yard with all improvements located. Before the improvements were undertaken the yards had 48 miles of track. They now contain 109 miles, an enlargement of 61 miles, which included a complete rearrangement. In addition to their size, these yards are said to be remarkable for the excellence of their construction and the neat, clean condition in which they are kept. The driveways at the freight sheds and team tracks have been paved with asphalt on a concrete foundation, which is in marked contrast with the recently abandoned team tracks which were approached during the wet season through mud axle deep. The stock yards are long enough to load and unload a 30-car train without spotting. These yards are floored with 3-in. plank and fully 25 per cent. of their area is under roof. The passenger coach yard contains 10 tracks, each of which is equipped with water, steam, air and gas. These tracks are placed 20 ft. centers so that cars may be washed and cleaned at any point in the yard. In the center of the yard is a

thawing-out house having capacity for four coaches. An acetylene gas plant, 30 ft. x 90 ft., is located close by, adjoining which are the passenger car repair shops and car cleaners' quarters.

At the passenger station there are three stub tracks on each side of the midway and four through tracks, all of which are arranged in pairs with 12-ft. platforms between each pair of tracks. The umbrella sheds which protect these platforms are connected to the concourse roof. All platforms are of concrete at rail level.

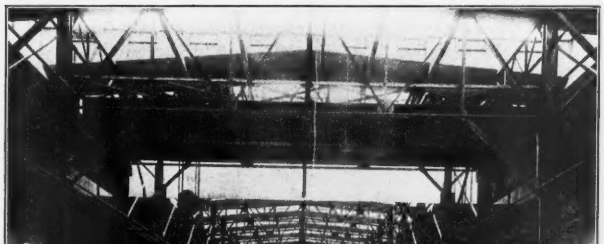
There are two modern coaling stations of the McHenry type, one for switching engines and the other for road engines. Each has four 25-ton pockets and a storage capacity underneath of 200 tons. Each pocket is provided with a dynamometer weighing device to enable the quantity of coal landed on each tender to be determined. There are two ash pits with depressed tracks. The pits are lined with concrete with hard burnt brick facings. The rails

Canadian Pacific Shops at Winnipeg.

on the pit side are supported on cast-iron columns to permit the ashes being shovelled from the pit direct into the cars.

The water is supplied by the company's own pumping at Red river, about two miles distant. A 50,000-gal. water tank acts as a reservoir from which supply pipes lead to the water columns and to hydrants between alternate stalls in the engine house. The piping system in the engine house is quite complete, providing for hot and cold water and steam and air. The steam pipes connect with the domes of locomotives in each stall, the steam from which can be used in the Sturtevant heater, for heating water for washout purposes, or can be transferred to the boiler of any other locomotive in the building. The engine house also contains a water-changing plant, and the turntable has lately been equipped with an air motor.

The new shops west of the main yard are in operation. They comprise a locomotive shop, 165 ft. x 794 ft.; blacksmith shop, 102 ft. x 217 ft.; foundry, 92 ft. x 122 ft.; pattern shop, 25 ft. x 104 ft.; passenger car shop, 100 ft. x 241 ft.; dry kiln, 42 ft. x 86 ft.; planing mill, 102 ft. x 217 ft.; freight car shop, 102 ft. x 313 ft.; oil



Interior of Shop, Showing Fixed 100-Ton Crane and Transfer Table.

house, 40 ft. x 80 ft.; power house, 100 ft. x 100 ft.; and a general store and office building.

The boiler and engine rooms of the power station are each 48 ft. x 124 ft. There are five 250 h.p. Babcock & Wilcox boilers with a working pressure of 125 lbs. Soft coal generally is used, although the shavings from the planing mill are fed by an exhaust system to the boilers. The boilers are equipped with a Sturtevant induced draft system and Green economizers. The ashes are conveyed by small cars on a 22-in. gage track through a tunnel under the boiler room and hoisted by jib crane to a cinder car outside of the power station. The engine room contains two Rice & Sergeant 900 h.p. cross-compound, non-condensing engines, direct-connected to 600 k.w., three-phase, 600-volt a. c. generators, built by the Canadian General Electric Company. There is also a duplex compound air compressor delivering 1,700 cu. ft. of free air per minute, built by the Canada Rand Drill Company. Other equipment includes two 1,000-gal. Underwriters' fire pumps, two duplex water pumps and two boiler feed pumps, built by the Canada Foundry Company.

An unusual arrangement is found in the locomotive shop, a 50-ft. transfer table being installed in the middle of same, as shown by the accompanying illustration. The wheeling and unwheeling of locomotives is done by a stationary 100-ton electric crane, which consists of two 50-ton trolleys on a runway formed of two girders fastened to the frame of the building in a fixed position directly over the transfer table pit. The engine is brought into position by the transfer table and is lifted off of its wheels by this hoist. The wheels are then taken away and shop trucks placed beneath the locomotive, which is then lowered and removed to an erecting pit. There are 30 erecting pits, and the remainder of the building forms the machine shop.

All of the shop buildings have concrete foundations, with brick walls laid in cement mortar, steel posts and trusses and slow-burning mill construction roofs. These roofs consist of 3-in. plank supported every 8 ft. and are covered with four-ply tar and gravel roofing. Each building is equipped with lockers, lavatories and Sturtevant heater fan rooms. The skylights throughout the buildings occupy fully 25 per cent. of the total roof area. The total cost of the shops was about $585,000.

Rapid Transit in Great Cities.*

One of the outcomes of modern civilization has been to collect populations into large centers, and with such segregation there has arisen a series of problems of which our forefathers took no heed at all or at most but little thought. A large city entails the supply of its people with light, heat, power, food, water, drainage, housing, pavements, and means of intercommunication. All of these problems, except the last, increase in difficulty and importance, substantially in direct ratio to the size of population. With transportation, however, the increase is as the square or even as the cube. Double the size of a city and you have not only twice as many people to carry, but you must carry them twice as far; and as the minute and not the yard is usually the proper unit of distance, doubling the distance means a doubling of speed. In New York, with its population of three and three-quarters millions, there are being carried now on the surface, elevated and subway systems paying passengers, exclusive of so-called transfers, 1,200,000,000 per annum, a number very much greater than the number of passengers on all the steam railroads of both the American Continents from the Atlantic to the Pacific, and from that most northern of all railroads, the Wild Goose Railway† near Nome, Alaska, within the Arctic Circle, to the most southern one in South America, the State Trunk Line of Chili. London with its population of over six millions, but with inferior intra-urban railway facilities, carries about the same number as New York; while Paris, Berlin, Hamburg, Boston, Chicago and St. Louis are fast following in the leaders' tracks. Such figures need no further comment or explanation to indicate the dimensions of the problems of transit in great cities, and the difficulty of properly meeting the continual demand for increase in facilities as cities grow.

The subject of the discourse and available time limit our consideration to *rapid* transit. We therefore pass by that other phase of urban transportation represented by the surface car. The present electric trolley car is a development of and evolution from the old omnibus, through the horse car, cable car, overhead trolley to the conduit trolley car to be found in New York, Washington and some foreign cities. Great as is the function of the surface cars as a means of short-distance local distribution, they cannot, by their very nature, be a factor in *rapid* transit. The frequent stops, and delays by other traffic in congested streets, necessitate a low average speed. To secure high speed the roadbed must be free from interference by other vehicles, and this requires that it must be elevated above the surface or be placed beneath it.

The elevated railroad is essentially an American design, having been suggested first by Colonel Stevens, of Hoboken, N. J., as early as 1830, only five years after the first steam passenger line was opened in England, and two years after a similar event occurred in America. It was not, however, for 40 years that the suggestion was given practical application, and then to avoid in New York the difficulties experienced in London of working an underground line by steam locomotives. This form of construction was extended in New York, or what is now the boroughs of Manhattan and the Bronx of that city, during the following ten years, resulting in the present elevated system, with a length of 38 miles of route. With the engineering details of elevated railroads every one is so well

*From an address delivered at Purdue University, by William Barclay Parsons, C. E.

†The Wild Goose line is the most northern railroad on the American Continent, but it terminates nearly 100 miles south of the Arctic Circle. The most northern railroad in the world runs from Lulea, at the head of the Gulf of Bothnia, in Sweden, to Narvik, or Victoriahavn, Norway, behind the Lofoten Islands, 135 miles north of the Arctic Circle.—[EDITOR.

acquainted that I will not take more of my limited time to refer to them here. This form of railroad, based on New York experience, has been reproduced in Brooklyn (now a borough of New York), in Boston and Chicago in our own country, and in Europe, in Liverpool, Berlin and Paris; although in the two last places the elevated lines are but super-surface portions of sub-surface railroads. When first built in New York, they were constructed on the general legal theory that as the courts had held that surface railways were a legitimate use of public streets without incurring damage to abutting property owners, so elevated railroads were but another form of surface railway and could claim the same immunity. After a long legal battle the converse of this proposition was finally established, and it was held that such railroads interfere with the so-called easements of light, air and access to abutting property, and therefore cause a damage. In streets already built up, and where no great corresponding benefit can be shown, such railroads have to pay large sums for land damage, sufficiently large in a city like New York to almost, if not quite, equal the difference in construction cost between the less expensive elevated and more expensive subway, which latter does not injuriously affect property.

The various elevated railroads above referred to are all of the type familiar to you. There is, however, another type for which its advocates claim special advantages, a specimen line having been constructed in Germany running through the contiguous cities of Barmen and Elberfeld. This railroad is a double line with a single rail for each track. The cars, instead of having their trucks beneath, have them on top, and are thus suspended from the single rail. Each truck consists of two wheels, the car riding therefore on four wheels, any of which can be made motor wheels according to power required.

We will now take up the other form of rapid transit railroad, the one beneath the surface. The first line of this character to be constructed was in London in 1865, but there the results of operating by steam locomotives were so disagreeable that no other similar move was made until another kind of motive power was possible. The next contemplated power was the cable, and the line built to receive it was the City & South London, the first of the so-called "tubes." But before it was completed in 1894, the practical feasibility of electricity as power on a large scale for transportation purposes had been amply demonstrated, so that an electrical and not a cable plant was installed. The attending success showed that it had become possible to use, with comfort and cleanliness, the great sub surface for transit purposes, a space hitherto considered of value only as a place wherein to bury sewers, water and gas mains in haphazard and disordered confusion. It is especially this use of the ground beneath our streets to which I desire particularly to direct attention.

As stated above, the first, and for 30 years the only, sub-surface underground railroad for local transit purposes was the combination of railroads in London known as the Metropolitan and District railways. To an engineer engaged in similar problems this first line is exceedingly valuable as a lesson or lessons of what not to do. The first lesson is the use of steam locomotives, filling the tunnel with smoke and noxious gases, though such use was then unavoidable as there was no other means at hand. Efforts were made to diminish the nuisance by condensing the exhaust, burning coke instead of coal, and a liberal use of ventilating shafts opening into back yards or streets, but without much success. At present an electrical plant is being installed* which will completely banish steam locomotives. The second lesson is the choice of building material, but for this the constructors were again in no way to blame. At that time steel, as we have it now, was unknown, and wrought-iron was too expensive for general use. The roof and walls were therefore made of masonry, usually brick work, and the roof given the regular arch form as common with tunnels. This resulted in depressing the rail level several feet, with corresponding extra cost and with an unnecessarily great distance to platform level. Occasionally at critical points a flat roof was resorted to, using cross-girders of cast iron. This work was, however, heavy and cumbersome. The third lesson is a mistake based on an error of judgment, and well illustrates a fundamental principle involved in the location of all rapid transit lines. The first idea in projecting the railroad was to connect by a sort of belt line several of the important railroad termini, whence the line was extended to encircle the business and commercial district of London. It was argued that, by giving a circular location it would be possible to reach or closely approach more of the important points than would be possible by any direct line. The result was one of those unfortunate compromises that pleases nobody. People do not want to be taken near a great number of points; they want to be taken directly to all if they can, if not, then to a few. The residents of London soon found that the existing means of slow communication by omnibus following direct lines of travel, going usually from point of origin to that of destination, gave better results than by a railroad underground with higher speed, but on a longer route and with usually a long walk at both ends. This fallacy of circuitous location is one that still finds adherents among the optimistic non-reasoning class to whom a compromise always appeals, and therefore is a fallacy that you may be called upon to meet.

While this first underground railroad system has never been a great financial success, some business, after 40 years, has developed along the route, and it is hoped that the application of electricity, with higher speed and greater comfort, may give a more satisfactory return.

The construction of the City & South London, with its electric installation, established a new order of things in two ways. First, it showed the feasibility of the new form of power application. Second, it showed the feasibility of tube construction. From this success a rapid development of underground construction began, and railroads of this character have since been built in Buda Pesth, Paris, Berlin and Glasgow in Europe, and in Boston and New York, with one now building in Philadelphia. Constructively speaking, these railroads are of two quite different types, the very deep, and the very shallow. The former is represented by the tubular construction. Although this form of construction was first put to a practical completion in England, it is really of American origin, a short sample line having been constructed some 40 years ago in New York by Mr. A. E. Beach, which sample still exists. In England it was developed by the late Mr. Greathead, in the City of South London, and afterwards by other engineers on three other lines, with two more now building.

These tubes have an internal diameter varying from 10 ft. 2 in. to 16 ft., according to the type of equipment it is proposed to employ. They are lined with cast iron plates, flanged on the inside. The thickness of the shell varies from 1 to 2 in., and the depth of the flanges from back to front from 4 to 8 in. The length of each ring of plates is about 1½ to 2 ft. In construction the rings of plates are put in place by the aid of a shield. These shields are cylinders of riveted steel plates, with an internal diameter very slightly in excess of the external diameter of the tube, and with a length of about 12 ft. About midway is a diaphragm of plates, with a horizontal platform in front, and with iron doors. The shield in front of this diaphragm is called the cutting edge and that behind, the hood. If the ground is firm like clay, partial excavation in front of the shield is made by hand, and then the shield is shoved forward by hydraulic jacks pushing against the completed tube and cutting the excavation exactly round. The jacks advance the shield the length of one ring. As the tail of the shield reaches back at least three rings, the cast-iron plates are put in place, bolted to each other and to the preceding ring through holes in the longitudinal and circumferential flanges, and then the operation is again repeated. The annular space outside of the tube left by the forward passage of the shield is at once filled with cement grout pumped from within.

If the material through which the tunnel is driven is not good, such as clay, but is sand or silt under water pressure, the operation remains substantially the same, except that an air lock is built within the tube and the space between it and the shield filled with compressed air to balance the external hydrostatic pressure. If the material be very soft, the doors in the diaphragm are partly or alternately closed; while if it is inclined to be fluid, like mud, all doors are tightly closed, and the shield, as a whole, shoved forward through it, the mud flowing to the sides. This last feat has been accomplished in the Hudson river tunnel at New York, now building.

The stations in tube railroads are constructed in a manner quite analogous to the tube itself, except that they have a diameter great enough to accommodate one track with a platform. The cars nearly fill the whole tube, for, of course, each tube contains but one track, and so act like a loose piston expelling the air in front, and drawing in other air behind. This action was expected to effectively ventilate the tubes, as it was believed that the expelled air would pass upward through the station entrance to the street. Tubular construction has the advantage of permitting construction to be carried on without disturbing the surface, and at a depth to avoid all interference with sewers and house foundations or other sub surface structures. The advantages are, however, offset by the great expense in construction of the iron lining and the large stations with their shafts, the cost of installing elevators and the expense of running them, and the failure of the ventilating system. This latter is due to the desire to avoid duplications of elevator service, so that the station tubes are cross-connected, both stations leading to the same elevator shafts. As these shafts are filled with the elevators, the air expelled by the trains finds the line of least resistance into the adjoining tube rather than upward, where it is drawn back again by the suction action of trains in the parallel tube. For these reasons other cities, except Glasgow in one instance, have adopted the shallow type.

This type had its first actual application in the subway at Buda Pesth, Hungary, where the walls were made of masonry in the usual manner, but the roof consisted of cross steel beams with concrete arches between them. Such construction permits the roof to come close to the surface and the cars to approach the roof with the minimum of clearance, thus decreasing excavation and the dis-

*Now in operation.—(Editor.)

tance from the line of the street to that of the station platforms, and, in short, avoids many of the defects in the design of the original London underground lines.

The Buda Pesth design has become the prototype of the subsurface lines in Berlin, Paris, Boston, New York and Philadelphia. In Boston and New York the first work done carried the principle of the use of steel beams one step further by placing them in the side walls as well as in the roof, and in New York they were introduced in the floor whenever there was an upward hydrostatic pressure, thus avoiding the use of heavy masonry to resist pressure by mere mass. Instead, such pressures are taken up by the steel beams, the thin masonry arches between them acting only to distribute pressure. A flat roof with steel beams on a two-track railway has a total thickness of about 2 ft., including clearance above the tops of the cars, while an arch of even flat section requires 5 ft., thus effecting a saving of at least 3 ft. in depth to rail level and of excavation, while there is a similar saving in each side wall of at least 2 ft., or 4 ft. in total width.

This use of beams was found to work so well that in the New York subway the principle of reinforced concrete was applied, and the beams in roof, walls and floor gave place to steel rods spaced 4 to 8 in., center to center, and next to the surface where tension is to be expected. Except in cases where concentrated loads, such as elevated railroad columns, are encountered, or heavy existing surface traffic has to be supported on newly erected structures, such design has been found in practice to result in work more economical in cost and more rapid in erection.

We therefore see that, generally speaking, the modern underground railroad of most approved type is either one that is very deep, entirely out of the way of other structures, when it is best built as an iron-lined tube, or else one brought as close to the surface as possible, in which the roof, walls and floor are a combination of steel and concrete, the former as either beams or rods, but in either case subject to exact mathematical analysis to determine shapes and sizes.

This rule must, however, be accepted as generalization. There will be found in all great works of this character times and places where for some reason it will be best to depart from the adopted type, and to revert even to the early form of tunnel, that with a masonry lined arch and invert. This has been done in Paris, Boston and New York.

So much for construction details, on which subject I have dwelt longer on subway rather than elevated design as offering more novelty and embracing a greater variety of details. In the matter of operation, substantially the same general principles apply to all rapid transit railroads, where the problem is how to move the greatest number of people over a given distance with the minimum of expense. Unless the mono-rail systems possess sufficient advantages to overcome their disadvantages and compel their adoption, nothing better has yet appeared than the ordinary railroad track of standard gage. This track should be of the heaviest type regardless of the light rolling stock, especially if high speed is to be attempted. Curves should be carefully spiralled, and super-elevation given, not according to a fixed rule, but varying with each curve and adapted to the speed that trains will make at that particular point. With cars you will find a field wide open for fertility in design, and where there is a contest between advocates of end doors versus side doors. Except for the all-metal cars recently introduced in the New York subway to eliminate fire risk, there is not much of striking novelty advanced, and nothing that has any great bearing on economy of operation except the facility to unload and load passengers. Every second's delay at a station repeated by every train, say, four times per mile, and at train intervals of one minute, means an increase in the number of trains required to maintain a given service. In spite of many manifest advantages of side doors, the tendency of practice is towards the type of American car with end doors, such cars having been adopted on the several lines in London and on the recently constructed combined subway and elevated in Berlin.

In the matter of motive power, the greatest advance has been made, and there probably remains the greatest possibility for future improvement. The steam locomotive, quite apart from the objectionable features of smoke, has already been permanently relegated to the scrap heap. For the moment, electricity is the only form of power that satisfies the requirements of the problem, and it will so continue until disturbed by some other. In order to maintain speed with frequent stops, the motors must have a high power of acceleration. In this respect the steam locomotive is sadly deficient. The best rate that the engines on the New York elevated could reach on loaded trains was .6 miles per hour per second, while the electric motors can give in actual practice 1.5 miles per hour per second. That is, in the first case 20 seconds were required to develop a speed of 12 miles, while only eight suffice in the latter case. Furthermore, the elevated motors can be distributed throughout the train and so avoid heavy concentration. On an express train of eight cars in the New York subway there are five motor cars, with two axles each, equipped with 200 h.p. motors, so that the total power per train is 2,000 h.p. This is the nominal rating, but the actual power, during a possible period of overload when accelerating, is at least 25 per cent. greater. To equal this in steam locomotive practice would call for two locomotives of the heaviest passenger type. These motors thus distributed through the train are, of course, under simultaneous control by the motorman at the head of the train, or in case of emergency at any other point.

Power for these motors is produced in large central plants. The largest of such plants as yet constructed is that of the New York subway, where the main units have an output capacity of 10,000 h.p., and where the total capacity of the whole plant, including subsidiary engines, is 135,000 h.p. The current as produced is of the alternating variety, and is generated at a pressure of 11,000 volts. As such it is carried to nine sub stations, averaging about two and one-half miles apart, where it is transformed to direct current and reduced in voltage to about 600 and thus fed to the line. The total weight of copper in the transmission cables on 21 miles of road in operation is over 6,500 tons, which would have been much increased if direct current alone had been used, and could have been reduced if alternating current could have been used throughout. The advance in design of the structural parts of elevated railroads or of subways with reinforced concrete walls has substantially exhausted any great possibilities in economy of design. This, however, is not true in respect to power and its application. The cost of power per car mile by steam operation on the New York Elevated was 12.18 cents; by electricity, under methods employed to-day, it is 9.47 cents, a reduction of nearly 20 per cent., while at the same time the average speed through quicker acceleration has been raised from 13 to 15 miles per hour. It is possible that, by means of higher steam pressure, turbines in place of reciprocating engines, higher voltage for transmission, the use of alternating current motors working at 3,000 volts, this cost can be still further reduced without imagining any radical departure from existing standards in practice.

In regard to operation, all but one of the rapid transit systems so far built are an extension of the principles of the surface service, that is, cars in units or in trains stopping at all stations. In New York, partially on the elevated lines, but more particularly in the new subway, the principle has been established in differentiating between the short and long distance traveler, and in giving to the latter a special train service on separate tracks, stopping at stations about one and one-half miles apart instead of one-quarter mile. This marks to date the maximum development in rapid transit facilities, a development, however, that will probably soon be repeated elsewhere, and will eventually be exceeded in New York by an express service with even higher speed, that is, with fewer stops.

Let us now turn from the engineering consideration of the question and briefly take up the legal aspect. The first established lines of transit were the omnibuses, which differed so little from other vehicles that their use of the public highway without special charge or tax was considered an obviously proper use. When the omnibus gave way to the horse car, it was held that such use was still proper, as the horse car was but an omnibus running on fixed lines, and the right to use public streets without payment was granted by the public authorities to street railway corporations. To-day, in practically every city in the United States, we find electric cars, the successors in turn of the horse cars and of their privileges, using public streets without franchise payment or at most with small ones. Such a result was not foreseen when omnibuses were first started. Now our economists are agitating a reversal of policy and demanding either that a proper payment shall be made for the right-of-way or that the title shall remain in the municipality, and that the right to run shall not be under a fixed grant but under a lease.

The modern rapid transit railroad is an exceedingly costly structure. The tubular railroads for two tracks, including stations and equipment, are costing in London about £800,000, say $4,000,000 per mile. Portions of the New York subway, with four tracks but exclusive of equipment, cost $5,000,000 per mile, and the total cost of the structure for 24 miles, of which six miles are elevated and therefore comparatively much less expensive than the subway, cost $2,000,000 per mile, and the equipment will add $750,000 per mile in addition. A large modern urban railroad represents, therefore, a great aggregation of capital and the forming of a corporation with necessarily great power, both financial, social and political. In this respect some people see such danger that they are demanding that all such railroads should belong to the municipality in which they are located and be operated by it. In England, where this movement has progressed further than here, many of the surface railways have been bought by the public authorities. As to the success of the movement there are widely different opinions. The experiment has not reached a definite conclusion. While awaiting the outcome no municipality has as yet undertaken to own and operate a rapid transit railway, although such ownership, without operation, has been retained in three cases.

The existing lines maintain their corporate existence in two ways, either by proprietary right, or by lease from the municipality. As examples of the former, are the London railways and the elevated roads in New York, where special privileges have been con-

ferred by law on the corporations, and they own, in their own right, the lines they have built. As examples of the latter, are the railways in Paris, Boston and New York. In each of these cases the subways were built by the city itself, out of public funds, and then leased to a private company to be operated by it. In Paris the railroads are first built by the city at its own cost and by its selected contractors, and then turned over, as each piece is completed, to the same lessor company to be operated by it, the company paying to the city of Paris one-third of the gross receipts as rental. If this sum exceeds the interest on the cost, the city of Paris is the gainer, otherwise a loser. The authorities therefore see to it that the work is economically conducted to keep down the interest charges, and that routes are selected which will return heavy traffic receipts. So far the results have shown a profit to the city of Paris.

In Boston the system of subways was constructed admittedly to accommodate the cars and trains of the company owning the surface and elevated lines. After the work of construction was completed, under the direction of an honest and capable board, it was leased to the railroad company at a rental of 4½ per cent. on the actual cost. As Boston can borrow money at a considerably lower rate, this return is sufficient to repay interest and allow for depreciation and a small profit, besides developing the city.

In New York the law provides that a contract shall be offered to public bidding, and that the contractor shall be paid by the city the amount bid by him for construction, and that he shall then operate the railroad for a period of years, paying as rental such interest on the cost as the city pays, and in addition 1 per cent. as a sinking fund. Although differing in details, the plans of Paris, Boston and New York have in common the general principle of ownership by the municipality, and thereby the retaining of control of the public streets. The terms fixed by these three cities are moderate, being at most little more than interest on cost, and as such tend to invite capital to embark in the building of these railroads. Such development is the prime object, and not municipal profit. In following the examples already set, other communities will do well to pattern closely and not impose burdens that will hinder rather than assist.

In studying the problem for the building of a new line or the reconstruction or extension of an old one, the engineer should be sure he understands all phases of the question. While it is his business to supply the public with the facilities that the public desire, and not what he thinks they should desire, nevertheless he must be sure that there is sound and permanent logic in public demand. The traffic routes should be analyzed to determine the trend of travel and reasons for it. Frequently arguments are advanced that railroads should not be built along congested streets, because they tend to increase congestion, but instead they should be built along other and less frequented streets so as to draw travel away from the congested routes. Travel is usually concentrated along certain routes for well-established reasons, and frequently in spite of lack of transportation facilities. In this case it is idle to talk of drawing travel away. People that have become set in certain ways are hard to change, and a line built off a line of travel is of little public benefit and is doomed to failure or to a long wait for business to originate before attaining success.

People also wish to be carried quickly. As our cities grow and distances increase, this question of speed becomes more and more important, as people measure the distance by minutes occupied in travel. Railroads for rapid transit should, therefore, so far as possible, be on straight lines, and if one straight line cannot reach all the desired points, then other railroads must be built as soon as business warrants. The mistake should not be made of sacrificing the best individual results in the attempt to partially satisfy many. These were the errors in the location of the first underground railroads in London, where the attempt was made to avoid congested routes and give a circuitous location.

The general type of the railroad to be built will also require careful consideration, whether elevated or subway, whether shallow or deep. Here one must be careful not to draw hasty conclusions that, because a certain type or method of construction has succeeded in one place, it will succeed equally elsewhere. This mistake was made in Brooklyn and Chicago after the initial success of the elevated railroad in New York. Then when once a type and general design have been adopted as best suited for the locality under consideration, the engineer must be on his guard not to be so closely wedded to his design as to fail to recognize when to vary it or even when to depart entirely. The New York subway is called an example of shallow construction, that is, as close to the surface of the street as possible, and so it is, for such was the motive of the design to be followed as much as practicable. Yet of the 24.7 miles of which it is composed 5.7 miles are elevated, 1.4 miles are in iron-lined tubes, 3.4 miles in deep tunnel, 1.2 miles in arched construction, and only 13.0 miles, or but little more than one-half of the whole, are of typical shallow construction, with a flat roof of steel and concrete construction. These changes were made for local topographical reasons, whereby better operating results were obtained.

In laying out rapid transit lines, it is found that people will not walk far to reach even a superior means of transportation, but are inclined to take the first at hand. For this reason one such road will not serve a very wide belt of territory, and the danger of disadvantageous parallel competition does not exist in anything like the same degree as with ordinary railroads operating in the same territory. New facilities of this character create their own traffic. The chief question arising is whether any particular route possesses in itself sufficient possibilities to justify the expensive construction. As parallel competition is not to be much feared, so new lines, even of an opposition corporation, should always be so constructed as to be capable of physical connection to permit through running. The whole tendency of American experience is towards consolidation of a city's transit lines. Our friends, the newspaper editors, and some of our other friends engaged in political strife, at times write and talk bitterly of local transportation monopoly. As a matter of fact, the public are better served when all lines are thus gathered together as a monopoly, and thus give the people the benefit of through running or of transfer.

In this respect the city of Paris has set a wise precedent, in creating a single private corporation to which are to be awarded all the rapid transit lines as fast as built. The municipal authorities there have thus boldly prevented any so-called competition, and have even organized a private monopoly. On the other hand, they have secured the certainty of operation of lines which, independent, would not pay to operate, thus affording means of rapid travel to all parts of the city, and have secured for the inhabitants the privilege of making any journey in any direction of even the greatest distance for a single fare.

London, on the other hand, is an illustration of the opposite plan. Of the six tube railroads now built or building, there are five different sizes calling for entirely different standards of equipment; so that, if ever these lines should come together under a single management, uniformity of management and physical connection are out of the question. Even with the surface lines, some of which are owned and operated by the London County Council, and others by private corporations, antagonism is so great that physical connections are prohibited, and necessary extensions of private lines prevented, thus making passengers change cars and actually depriving the public of much needed facilities. In these two great cities we see, on one hand, monopoly working smoothly for its own advantage and the public benefit, and on the other, competition existing to the point of general injury, public as well as private. So acute have become the London conditions that the British Government has had in existence for two years a Royal Commission studying the problem, with a view of proposing some remedial measures.

In judging of the value of traffic routes, two chief considerations must be kept in mind. First, mere density of population does not of itself signify great traffic returns. A certain portion of the population of great cities, and usually that which is densest, is not migratory, but being clustered around its work has little cause to go to other parts of the city. On the other hand, there are neighborhoods where the population is much more sparse, but where the residents leave their homes for business, shopping, visiting, school and entertainment. One must differentiate therefore between traveling and stationary population. This is well illustrated in New York, where one of the elevated lines traverses the celebrated tenement house district, where more people live per acre than in any other city of the world. The traffic returns are very low. Other portions of the line traversing districts where the population is not one-tenth of the former show receipts several-fold greater. Second, special points of occasional crowding are not so productive of traffic as they would seem to be. Recreation grounds and parks used occasionally or on certain days or seasons are illustrations, and even terminal stations of great railroads. To again quote from New York experience, when it is remembered that the Manhattan Elevated and Subway systems alone, on but a little over 50 miles of road, carry two-thirds as many passengers as do the steam railroads of the United States on over 200,000 miles, it needs no demonstration to show that the number of passengers interchanged with the Grand Central Station, the terminus not only of the New York Central system, but of the New England railroads as well, does not constitute a large percentage. Even in London, where the facilities are inferior to an American city, the Board of Engineers in their report advising the Royal Commission above referred to, show that one trolley terminus where the lines, through opposition, are compelled to stop short of ultimate destination, discharges and receives more passengers than are similarly handled at six large railroad passenger stations combined. A street passing through a commercial or shopping district, with places of entertainment in the neighborhood, is a much more desirable district to reach from the point of financial return, and more necessary from the point of view of public convenience, than the greatest railroad terminus or most popular ball ground.

Contracts for locomotives to be delivered in South America and Asia, to the amount of about $3,000,000, have been let recently, chiefly to German and Belgian works, so a Berlin newspaper reports. The German works are said now to have orders which will keep them busy for several months.

Treated Tie Data from the Santa Fe.

Mr. E. O. Faulkner, Manager Tie and Timber Department, Atchison, Topeka & Santa Fe, has prepared the accompanying diagrams, which present in graphic form information relative to treated ties. The first of these (Fig. 1) shows the number of treated ties laid in all of the railroads of the United States from 1885 to

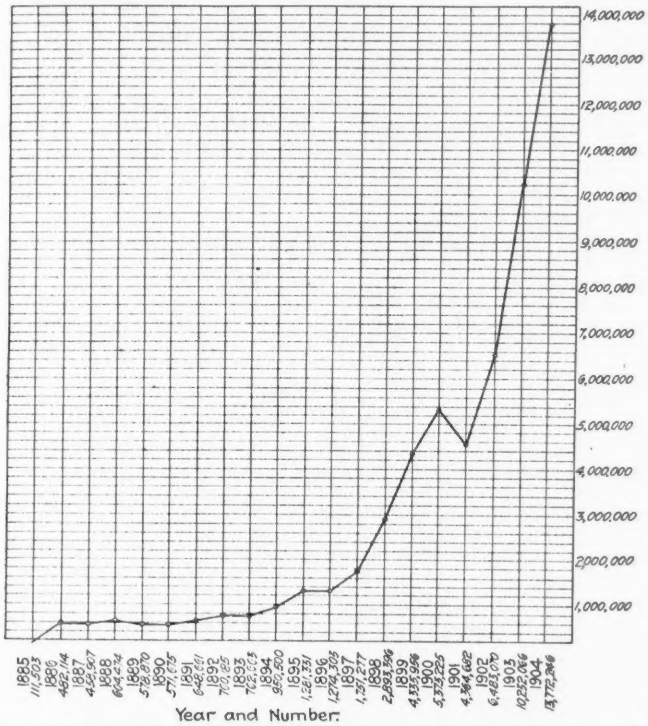


Fig. 1—Number of Treated Ties Laid Each Year by Railroads of the United States.

1904 inclusive. The ordinates represent amounts, increasing by 200,000, and the abscissae years, the number laid each year also being given under the year. The rapid increase beginning with 1897, the slight falling off in 1901 and the enormous and steady increase since that time are the notable features of the diagram.

The next two diagrams are Santa Fe records, the first (Fig. 2) showing the number of ties inserted in track on the entire system from 1885 to 1904 inclusive. This diagram is similar in general form to Fig. 1. The greatest percentage of increase, however, was in 1898, although the greatest actual increase was in 1904. The total for the 20 years is 15,211,730.

The third diagram represents the percentage of treated ties removed on the divisions east of Albuquerque, N. Mex., 1897 to 1904 inclusive. The dates on the curves represent the year in which the ties were laid, the dates at the bottom the year removed on account of decay, and the ordinates represent percentages of removal.

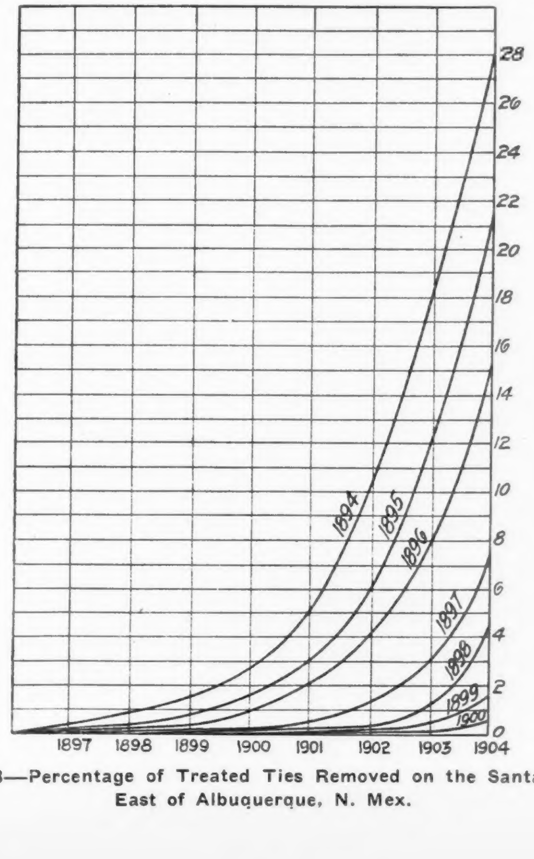


Fig. 3—Percentage of Treated Ties Removed on the Santa Fe, East of Albuquerque, N. Mex.

The department has also issued a circular to show standard

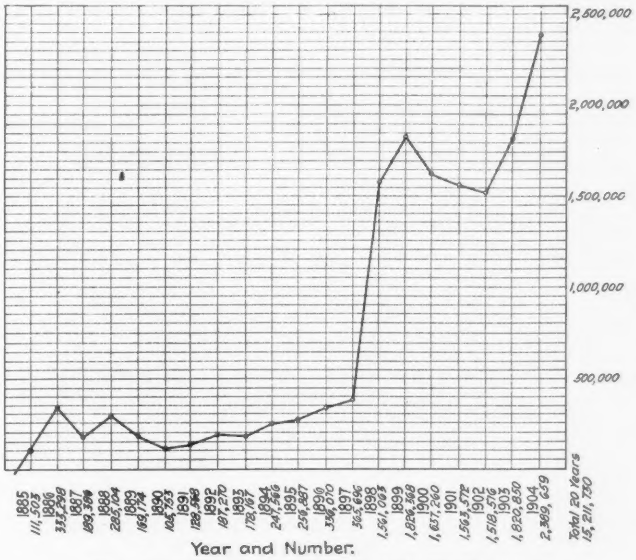


Fig. 2—Treated Ties Laid on the Santa Fe.

forms for piling ties, and piling poles in yards and on the right-of-way, before and after treatment, with the approved method of roof building to shed water. There are nine figures on the circular illustrating respectively a triangular pile, open crib pile (four ties each way), an 8 by 1 and an 8 by 2 pile (though the first figure may be made any convenient number), edged pile (the outside ties in each course being laid in edge), solid pile roofed, and a solid pile without roof (for cypress ties only). The two remaining figures show method for piling and poles, the butts and tops to be reversed in each course; and the proper way to lay sawed ties or timber, the year rings all pointing downwards. The following instructions are printed on the circular:

1. Ties must be piled in accordance with pile numbers best suited to local conditions.

2. Ground supports of sound stuff, giving less than 6 in. clear

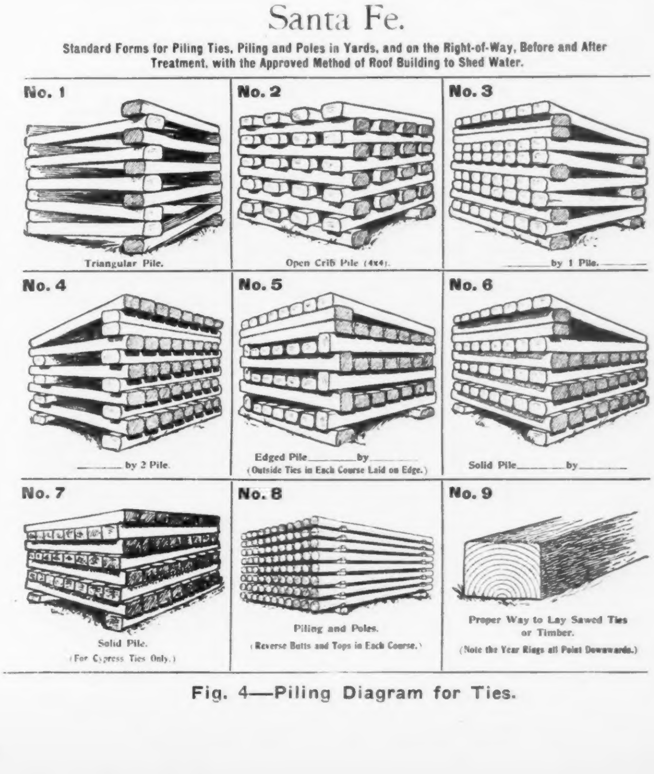


Fig. 4—Piling Diagram for Ties.

air space, must be used, and no rotten or decaying wood allowed to remain in any yard or near any pile. In piling ties, not more than two for each pile should be in contact with the ground, excepting in triangular piles, as shown in No. 1 above.

3. Where roof courses are required, particular care should be taken in constructing them so as to obtain the desired protection, sufficient material necessary for this purpose being used.

4. In storage yards, each pile should be plainly marked with the month and year in which received, these marks to be placed where they can most easily be seen, and a clear space, preferably 4 ft., left between each row of piles to facilitate seasoning.

5. Material must not be piled where any part is likely to come in contact with water, or where water can stand or run, on surface of ground, under the piles.

6. Tall weeds or high grass must not be allowed to remain near any material piled on the railroad company's property.

7. Treated ties must not be placed in service until they have seasoned the full time prescribed for that purpose.

Changing the Gage of the East St. Louis and Suburban.

The East St. Louis & Suburban operates 111 miles of single track city and interurban lines in East St. Louis and surrounding towns and has developed quite a large industrial switching business in its territory on the east side of the Mississippi river. Its lines have gradually been built up from the small system of electric street car lines originally built on a few streets in East St. Louis by interests allied with the St. Louis street car companies across the river. The St. Louis street car lines were laid out for a 4-ft. 10-in. gage, and in order to make it possible to run suburban cars over the Eads bridge and on the same tracks in St. Louis the electric roads out of East St. Louis were likewise built to a 4-ft. 10-in. gage. Some time ago, however, the East St. Louis & Suburban determined to change all of its tracks to standard gage, 4 ft. 8½ in., and to abandon the running of its cars on the St. Louis street railway tracks. Two reasons prompted making the change; one, that it was desired to make it possible to run the same work and line cars in use on the passenger lines over two freight lines operated by the company which were 4 ft. 8½ in. gage, and a more important reason was a desire to have all the tracks in East St. Louis of standard gage in order to be able to afford terminal facilities in the city and on the bridge for new lines which might be built from any direction to East St. Louis. It was first thought that the change would be made on the entire system in three or four days, but on mature deliberation it was decided to spread the work over a longer period, in order to interrupt traffic less.

There were three suburban divisions to be changed, one double-track running from East St. Louis to Belleville, one single-track running from East St. Louis to Edwardsville, and one single-track running from Edgemont to Collinsville (connecting the two first named divisions). Having made thorough preparation first, the Belleville double-track division was changed in one day, one track in the forenoon and the other in the afternoon. During the change of each track, cars were run at 20 minutes headway on the other track, passing at crossovers, so that service was practically uninterrupted on that division during the change. The Edgemont-Collinsville division was changed in one morning, and the East St. Louis-Edwardsville division in two mornings, one forenoon being used between Collinsville and Edwardsville and the other between Collinsville and East St. Louis. In this way traffic was interrupted but a few hours on even the single-track lines. In East St. Louis the detached divisions of the city railway lines—those from which transfers are made to through lines—have been changed one at a time. When this was completed the through lines were taken in sections, so that by transferring passengers, practically no interruption of traffic occurred.

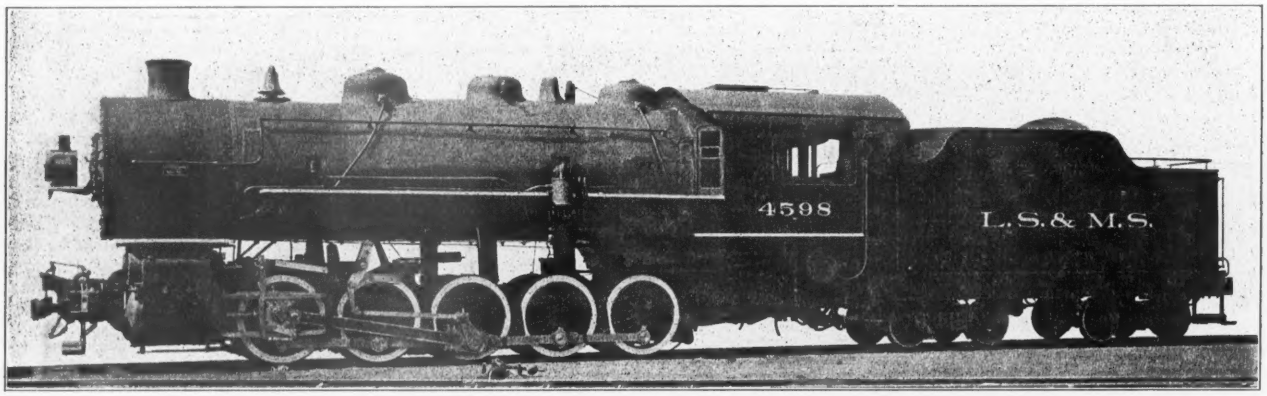
By reason of this gradual change, and the fact that the company was well fixed for surplus equipment, the shops were able to make changes of cars to keep pace with the requirements for 4 ft. 8½ in. cars. Much of this work in the shops, however, went on for several weeks prior to the actual change; that is, turning down of axles, arranging for changing brake rigging, etc., so that when the final actual change of cars was required, it was done in very little time. To facilitate this work the company purchased a considerable number of new wheels and axles.

The whole work of changing gage was made the subject of careful study and preparation, and proceeded with practically no interruption of service, and without the necessity of expensive night work, except gangs cutting special work, railroad crossings, etc., this latter work having been done mostly at night. A careful estimate was made of the probable cost before the work was commenced, and it was done at some saving on the original estimate.

Tracks in the shops were arranged so that standard gage cars could be brought in from the rear and wide gage cars in front, the wider tread of the wheels of the suburban cars making it possible to run them over the 4 ft. 10 in. pits after the gage had been changed to 4 ft. 8½ in. The few city cars on lines already changed are kept out on the line nights and not brought to the shops unless needing serious repair, which latter contingency has not yet arisen. These cars get nightly attention on their tracks for light repairs, oiling, etc.

Powerful Switching Locomotives for the Lake Shore.

The accompanying illustration shows one of the heavy switching engines recently ordered from the Brooks works of the American Locomotive Company by the Lake Shore & Michigan Southern. They are by far the largest and most powerful switching engines yet built and are intended solely for pushing trains over the humps in gravity yards of which the Lake Shore now has a number. This service requires an even more powerful engine than road service since the switching engine must be able to take the heaviest trains as they come in off of the road and push them up the comparatively steep grade of the hump. These engines have all of their weight, 270,000 lbs., distributed on five driving axles, which gives a weight on each axle of 54,000 lbs. In only one engine, the Mallet compound of the B. & O., has this weight on drivers been exceeded or even approached. The wheels are only 52 in. in diameter as the speed at which the engine will work is seldom over 10 miles an hour and great power is the essential aim of the design. The cylinders are very large, 24 in. diameter x 28 in. stroke, but ample boiler power has been provided to supply them with steam. The boiler has 447 tubes, 2 in. in diameter and 19 ft. long, giving a tube heating surface of 4,422.4 sq. ft. and a total heating surface of 4,625.4 sq. ft.



Ten-wheel (0-10-0) Switching Engine for "Hump" Yard Service—Lake Shore & Michigan Southern.

Another noticeable feature of these engines is the use of the Walschaert valve gear, which is well adapted to such a design in which there is very little room for eccentrics and links between the frames on account of the crowding in of five axles in a 19 ft. wheel base. All of the ten wheels are flanged. The following table gives the principal dimensions of these engines:

Kind of fuel	Bituminous coal
Weight on drivers	270 000 lbs.
" total	270 000 "
" engine and tender, loaded	419,600 "

General Dimensions.

Wheel base, total of engine	19 ft.
Wheel base, engine and tender	54 ft. 5¼ in.
Height of stack above rails	14 " 10½ "
Height to center of boiler from rails	9 " 7 "
Heating surface, firebox	203.0 sq. ft.
" " tubes	4.422.4 "
" " total	4,625.4 "
Grate area	55 "

Wheels and Journals.

Drivers: Number	10: diameter 52 in.
Drivers, material of centers	Cast steel
Journals, driving axles, size	10½ and 9½x12 in.

Cylinders.

Cylinders, diameter ....24 in.
Pistons, stroke ....28 "
Piston rod, diameter ....4½"
Piston packing ....Cast-iron snap ring

Valves.

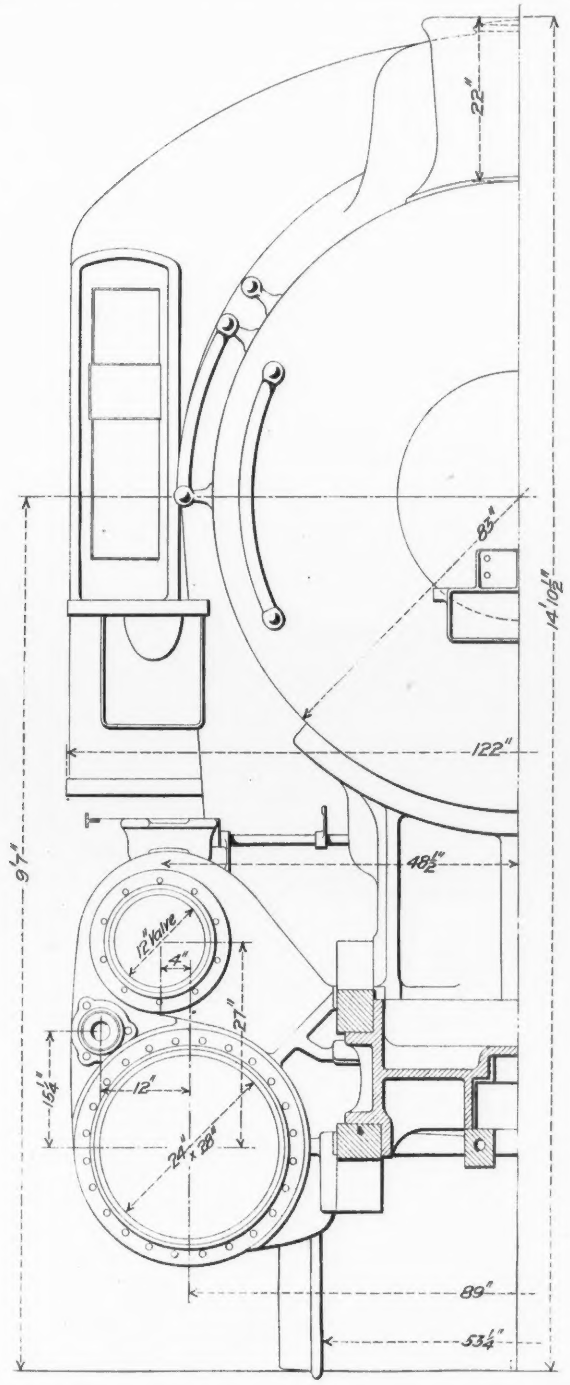
Kind of gear ....Walschaert
Kind of valve ....Piston, 12-in. diameter
Maximum travel ....5⅝ in.
Outside lap....................1 in.; Inside lap ....None

Boiler.

Type of ....Extended wagon top
Working pressure ....210 lbs.
Diameter of barrel, first ring..80¹/₁₆ in.

Firebox.

Length ....108⅛ in.
Width ....73¼ "



Half End Elevation of Lake Shore "Hump" Switching Engine.

Thickness of sheets.......Crown ⅜-in., tube, ½-in., sides ⅜-in., back ⅜-in.
Water space, width ....Front 4½ in., sides 4½ in., back 4½ in.

Tubes.

Number 447
Material ....Charcoal iron
Outside diameter ....2 in.
Length ....19 ft

Other Parts.

Exhaust nozzle, single or double ....Single
Stack, diameter ....20-in...

Tender.

Tank capacity ....8,000 gals.
Coal capacity ....12 tons

Connecticut's New Railroad Legislation.

BY CLARENCE DEMING.

For more than ten years and down to the Connecticut legislative session of 1903 the story of railroad legislation in the state had been mainly the tale of the conflict of steam and trolley interests centered on the construction of electric parallels. The long campaign of more than ten years opening with successes of the New York, New Haven & Hartford Railroad Company closed with several years of consecutive defeats; so that, at the legislative session two years ago the whole situation had changed. By that time profitable trolley territory in the state had become almost exhausted; and the New Haven Company itself, as it had acquired large electric properties, had found its own interests shifted largely to the side of its earlier foes. In the legislative session of 1905, lately closed, the same situation has repeated itself in a more accentuated form. Not a single contest of steam and trolley worth noting has been fought during the whole session; and the New Haven Company has centered its energies either on its great electric interests or on securing new privileges as a steam corporation.

In what may be called the electric direction the New Haven company accomplished its prime object of the session in carrying through a resolution "amending the charter of the Consolidated Railway Company," the holding corporation in which are vested its great system of electric lines. The amendment is, in fact, a new charter expanding lavishly the powers of the old charter—taken over from a corporation in eastern Connecticut—and already liberal, not to say excessive. The new charter even without reading between the lines, seems practically limitless in its scope of public service function and activity. Under it the big holding corporation, owned by the New Haven Company, can acquire "any property or instrumentalities, lawful and suitable for any such purpose or directly or indirectly connected with the business of transportation." Present location and construction are confirmed and new rights of extension given specifically on routes the brief description of which fill almost ten pages of the charter—this by way of pre-emption rather than positive intention to build. Water power in the state for all kinds of electric purposes can be acquired indefinitely. Any other corporation engaged in transportation or development of electricity can be bought up and its franchises, rights, powers and privileges pass to the Consolidated Railway Company, and minority stock of one-third or less may be condemned. Unlimited power is granted to take up the liabilities of absorbed corporations and very free exercise of eminent domain in taking realty. The only checks in this "omnibus" charter relate to the construction of parallels and the infringement of local charter rights already granted to other steam and electric railroad corporations.

The size of the holding company to which these great powers have been granted by the Connecticut legislature is worth attention. It is made up of 20 constituent properties, owned, controlled or leased, and representing a much larger number of corporations originally independent. Of these constituent properties, 13 are in Connecticut and seven are in Massachusetts. In approximate figures they have 553 single track miles; $18,439,320 of stock; $24,109,900 of funded debt; and $1,925,784 of floating debt—these figures including the stocks of a holding sub-company by which the Springfield street railway has been financed. A large amount, however, of the stock, bonds and floating debt is held by the Consolidated Railway Company, acquired or issued in the various "deals" by which the merged properties have been obtained. In the hands of the public, including about $9,500,000 of the parent steam company's debentures, by which the Fair Haven & Westville system was bought, there are approximately $32,971,720 of securities connected with the Consolidated Railway organization now outstanding and probably still more to come. How far the sweeping new charter of the big electric holding corporation will hold as against Massachusetts law in connection with its lines in that state is an interesting question of the future.

But the grant of new powers did not end with the New Haven's holding corporation. The original charter of the steam company was itself amended so as to allow the New Haven to acquire directly by purchase, lease or otherwise the stock, property, rights and franchises of any railroad which it now operates, dispose of the same and in the transactions issue its own stock, bonds on notes; and, in case it acquires all the shares of any Connecticut railroad, it becomes vested with all the charter rights and privileges of the acquired line. A three-quarters stock interest can sell a railroad line to the New Haven and with the transfer goes condemnation rights over the minority stock—an existing law of the state, with some important additions, being thus made a part of the New Haven's charter. The extent to which the old but subtle stratagem of gaining new charter privilege by the device of vesting the central corporation with the charter powers of acquired roads has been used, will be marked in both the case of the New Haven and its electric holding company.

The middle of the session brought out a new and dramatic feature of railroad policy—the so-called "open air lobby" of President Mellen. Other and earlier presidents of the New Haven Com-

pany had from time to time and on specific bills addressed the railroad committee; President Mellen, in view of the largeness of his plans and policy, deemed the time ripe for a kind of "omnibus" address covering all the railroad questions before the General Assembly. It took the form of a sort of great legislative town meeting held in the hall of the house of representatives which was crowded by several hundred listeners. To them President Mellen, who is gifted with fluent and persuasive speech, expounded the policy and projects of his corporation in many phases—charter powers, consolidations, electric plans, demurrage, the general railroad law, freight rates and facilities and cognate themes—laying special and, as appeared in the sequel, effective stress on state protection against the newly surveyed line of the New York Central across northwestern Connecticut. A long and, at times, sharp, "quiz" followed from members of the legislature and others, the whole proceedings filling several hours and bringing out with singular clearness not merely Mr. Mellen's grasp of general situations but also his command of details.

It is hardly too much to say that one of the direct results of President Mellen's appeal was the securing of a point of vantage for his corporation in seeking which two years before his predecessor, President Hall, had signally failed. Not long before the meeting of the legislature of 1903 an outside syndicate had planned a long distance electric line from Hartford to New Haven via Middletown—the new line to be a competitor of the New Haven and a prospective link in a larger electric system between New York and Boston. The plan of the projectors was to build the new line under the general railroad law of the state—a statute which, along with some sane restrictions on capitalization, allowed a steam railroad or electric railway to be built without seeking new legislative powers. President Hall met the project—which ultimately fell through—with a bill to repeal the general law; but after a vigorous effort was forced to withdraw the measure, the "farm element" in the General Assembly, very friendly to electric enterprise, actively resisting him. In leveling the same shaft against the New York Central President Mellen hit his mark. His plea for "protection" for home interests and against "punishment" for connecting the state with the coal fields by the Ontario & Western purchase availed. The legislature promptly repealed enough of the general railroad act to compel a line crossing the Connecticut boundary to obtain special legislative sanction; so that now any project of the kind must carry the Connecticut Senate, long a fastness of the New Haven corporation. As a rivet of that company's territorial monopoly in the state and in southern New England this action of the Connecticut legislature is quite unique in its railroad annals.

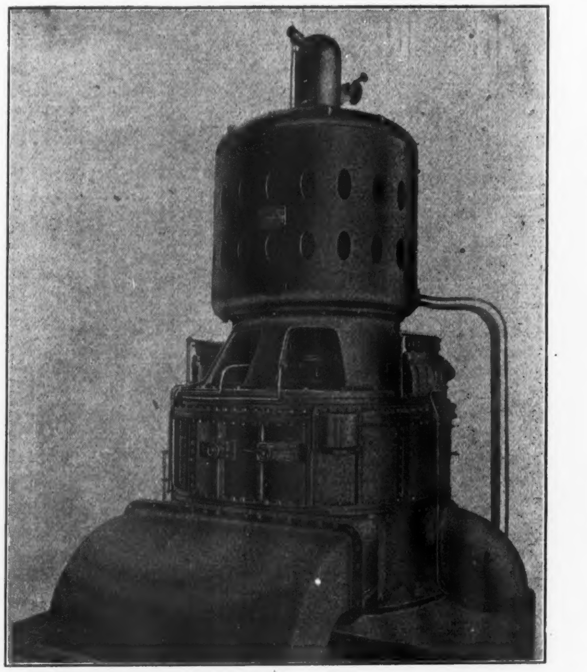
The New Haven Company carried through yet another measure of considerable importance to it in future financing of electric enterprises. This was the opening to savings bank and trustee investment of the debentures of the Consolidated Railway Company, the electric holding corporation already described. The debentures, of which some $14,000,000 are outstanding, are not a formal mortgage security although they must be provided for before additional mortgages can be laid on the properties of the Consolidated Railway. On the plea that it would be unjust to open to savings bank investment a debenture and refuse it to a mortgage bond the consolidated mortgage bonds of the Connecticut Railway & Lighting Company—some $11,000,000 outstanding and more to come—also obtained the savings bank legalization. In both cases is now presented the striking inconsistency of junior bonds of the two great Connecticut trolley systems legalized for investment of savings banks and trustees while most of the much more highly secured underlying bonds of the constituent properties are denied that investment vantage.

At one point and one point only during the session was the New Haven Company worsted. Before the meeting of the legislature it was expected that a strenuous effort would be made by the company for the repeal on modification of the Connecticut four-day car detention law which has been costing the corporation upwards of $1,000,000 a year. A bill was actually introduced and, as a "compromise" measure, received the approval of the Connecticut Manufacturers' Association. But it met with vigorous opposition from the rural legislators and was finally withdrawn—possibly on the theory that it was overloading and imperiling other legislation asked for. In the legislature two years hence this demurrage matter promises a more active contest. Meanwhile, by enforcing orders for quicker return of foreign cars, the New Haven company has succeeded in cutting down detention costs some 40 per cent.

Many minor bills aimed at the railroad and street railway companies—measures for third rail protection, abatement of smoke, more train hands in ratio to cars, street cleaning from snow, jury trials in damage cases, lower trolley fares and others—went to defeat, usually in the Senate; and in the session, as a whole, the grant of railroad privilege has far exceeded that at any law-making period in the history of the state. For the first time "community of interest" between steam and the trolley has been well nigh complete—partly because the New York, New Haven & Hartford Railroad Company has itself become so extensive an owner of electric roads, partly because rival territory has either been used up or pre-empted in existing charters, and partly because destiny has pointed to the early absorption by the great steam corporation of the large Connecticut Railway and Lighting system. With that final step in electric railway consolidation accomplished and nine-tenths of the street railways of the state under the New Haven's control, Connecticut railroad law making will be interesting, perhaps, but hardly polemical.

Tests of a Curtis Turbine Generator.

On May 3, 1905, Messrs. Louis A. Ferguson, Vice-President of the Commonwealth Electric Company, and Frederick Sargent, of Sargent & Lundy, Chicago, Ill., made an efficiency test at the Schenectady works of the General Electric Company of a 2,000 k.w. steam turbine generator unit of the Curtis type, which surpassed all previous records for economy in steam consumption for turbine generators. The turbine was a four-stage machine designed in 1903 and recently changed in a few particulars as a result of experiments made during the past year. The machine as tested conforms as nearly as possible to the standard four-stage machines now being produced, but is less efficient since the changes which were made were confined to the buckets while several other important changes, known to be desirable, could not be made in this case without rebuilding the entire machine. It has a normal



2,000 K. W. Curtis Turbine Generator Unit.

full-load capacity of 2,000 k.w. and operates at 900 r.p.m. The remarkable results here reported were determined by the most accurate methods and have been verified by repeated tests made subsequently in which the same conditions of steam pressure, vacuum and superheat were maintained.

The following is the full text of the report of the engineers, Messrs. Sargent and Ferguson:

"We sent our assistants, Messrs. Clark and Eastman, to Schenectady to prepare the apparatus for making these tests, and they made several preliminary trials before our arrival and the results of each of the trials very closely approximated the results of the official tests herein mentioned. We had all the instruments carefully tested and standardized during the trials; the electrical instruments being tested by the New York testing laboratory in the presence of Mr. Eastman. The surface condenser showed practically no leakage. We took every precaution to satisfy ourselves that the tests were reliable and accurate, and we beg to certify that the results obtained were as follows:

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	Test: Full load.	Half load.	Quarter load.	Zero load.
Duration of test, hours	1.25	0.916	1.0	1.33
Steam pressure (gage), lbs	166.3	170.2	155.5	154.5
Back pressure,* in. of mercury	1.49	1.40	1.45	1.85
Superheat, degrees Fahr.	207.0	190.0	204.0	156.0
Load in kilowatts	2,023.7	1,066.7	555.0	.....
Steam consumption per K.-W. hr., lbs.	15.02	16.31	18.09	1,510.5

*Absolute

It will be seen from this summary of the results that the generator unit gave an electrical horse-power on 11.205 lbs. of steam per hour at full-load, which, assuming 85 per cent. combined efficiency, is equivalent to 9.52 lbs. per indicated horse-power per

hour for a reciprocating engine. This figure has been surpassed in one or two instances, notably with a triple expansion, four-cylinder horizontal Sulzer engine using steam at 180 lbs. pressure superheated 230 deg. Fahr., which under a load of 2,860 h.p. gave a steam consumption of 8.97 lbs. per hour. But in commercial service the usual figure for the best reciprocating engines is from 12 to 15 lbs. per hour. The high economy of the turbine tested is, therefore, apparent.

Output of the United States Steel Corporation.

The Bulletin of the American Iron and Steel Association publishes a table in which the percentage of the total shipments of iron ore from the Lake Superior region by the United States Steel Corporation as compared with the shipments of iron ore from the same region by all other companies, firms and individuals, and the percentage of the total production of iron ore, coke, pig iron, steel ingots and castings, finished rolled iron and steel and wire nails by the Steel Corporation and by all independent producers, both for the years 1902, 1903 and 1904 are given. In the three years covered by the table production of iron ore by the steel corporation fell from 45.1 per cent. of the total in 1902 to 43.8 per cent. in 1903, and to 38 per cent. in 1904. The considerable decrease in 1904 was due principally to the large stock of iron ore carried over from 1903. The production of Bessemer steel rails by the corporation declined from 65.4 per cent. in 1902 to 57.2 in 1904. The decrease in the latter year was caused mainly by the competition of the Lackawanna Steel Company, an independent concern which was an active competitor for Bessemer rails in 1904, its new plant having at that time only recently been put in operation. The increased production of open hearth steel rails from southern rail mills also influenced the result. The production of the Steel Corporation also shows a decrease of 3 per cent. during the three years in the total of all kinds of finished iron and steel, including rails. The table for 1904 follows:

Percentage of Shipments and Production by the United States Steel Corporation and by Independent Producers.

	1904	
	United States Steel Corporation.	Independents.
Shipments of iron ore from Lake Superior	53.8	46.2
Total products of iron ore	38.0	62.0
Production of coke	36 6	63.4
Bessemer, basic, forge, foundry; all other pig iron	44.3	55.7
Spiegeleisen, ferro-manganese and ferro-phosphorus	70.5	29.5
Total pig iron, including spiegeleisen, etc.	44.6	55.4
Bessemer steel ingots and castings	69.0	31.0
Open-hearth steel ingots and castings	50.4	49.6
Total steel ingots and castings	61.0	39.0
Bessemer steel rails	57.2	42.8
Structural shapes	55.1	44.9
Plates and sheets, excluding nail plate	58.0	42.0
Wire rods	71.3	28 7
Bars, skelp, nail plate, open-hearth, iron rails, etc	28.6	71.4
Total of all finished rolled products	47.8	52.2
Wire nails	67.0	33.0

The Cost of Locomotive Operation.

VIII.

BY GEORGE R. HENDERSON.

(*Continued from page* 11.)

EFFECTS OF BAD WATER.

If the natural waters are poor and no methods of purification are adopted, there will be contingent expenses created which may be briefly summed up as follows:

Waste of fuel, by blowing hot water from the boiler, in order to reduce concentration.

Waste of fuel, by incrustants fouling the heating surface, and preventing the ready transmission of heat to the water.

Time and labor necessary to wash out the boilers frequently, and waste of heat.

Time and labor in making frequent and elaborate repairs to the boiler.

Detention of trains on the road, due to poor steaming and foaming, as well as possible accidents to fire-box, cylinders, pistons, valves, etc.

When the water has a natural foaming tendency, or such is caused by the addition of soda ash, the concentration must be kept down by frequently blowing off. Some of the instructions issued in connection with the use of soda ash prescribe that at the end of each trip, at least two gages of water shall be blown out of the boiler, and special blow-off cocks, operated by air from the cab are provided for this purpose. For a locomotive of moderate size, this means that about 4,000 pounds of hot water are to be ejected from the boiler, to each pound of which in the neighborhood of 340 heat units have been added, or a total of, say, $340 \times 4{,}000 = 1{,}360{,}000$ B. T. U. As the efficiency of the boiler will permit, perhaps a utilization of only 7,000 heat units per pound of coal, we find that this represents an amount of fuel of $\frac{1{,}360{,}000}{7{,}000} = 194$ pounds, or about one-tenth of a ton of coal! Besides, it is frequently necessary to blow out while on the road, and this represents further losses.

Consequential losses have also sometimes resulted, by persons or property being damaged while blowing off, when the attachment is on the side of the fire-box. If directed back under the train, it is apt to throw sand, gravel, etc., into the journal boxes, causing hot bearings.

If scale is allowed to accumulate on the heating surfaces there will be a loss of heat, as was referred to in Chapter 1, in the discussion of the condition of the boiler. This, of course, depends entirely upon the water used, and the thickness of incrustation. The Illinois Central tests showed only 1/32 inch average thickness of deposit after running the engine 21 months. Many waters would produce this much in a month or less. Professor L. P. Breckenridge, who reported the tests, estimated that approximately one-fifth per cent. of the fuel burned was wasted or lost for each month that the engine ran between cleaning of the boiler; thus, in ten months the average loss would be about two per cent.; in 20 months, four per cent. This, however, would be very little guide to conditions existing on other railroads, except in the general way, that the dirtier the boiler is allowed to run the greater is the heat loss, and this is chargeable directly to the impure water used.

The cost of washing out boilers is quite considerable, especially if it is thoroughly done, as should be the case, and we may estimate it about as follows:

One hour for boiler washer	25 cts.
One hour for helper	15 "
3,000 gals. water (worth 10 cts. pr 1,000 under press)	30 "
2,500 gals. water for filling up	25 "
½ ton coal, to get up steam at $1.00 a ton	50 "
Total	145 cts.

or, say, $1.50 for material and labor. Washing out has been accomplished with a detention of little over an hour, but we do not think it ordinarily wise to consider less than three hours needed for cooling, washing out and firing up. In oil burners, where the internal brickwork stays hot for such a length of time, it cannot be done under from 6 to 10 hours. If the locomotive costs $15,000, the interest at 5 per cent. will amount to 8 cents an hour, which ought, perhaps, to be considered in addition to the above. However, $1.50 will probably represent the actual cost of this process under ordinary circumstances.

With many poor waters, boilers must be washed out every 600 or 1,000 miles' run, but in *bad* districts this must be done every round trip, say, for each 300 miles. If the engine ordinarily uses 300 gallons of water per mile, at a cost of 5 cents per 1,000 gallons, we should have for 300 miles, $\frac{300 \times 300}{1{,}000} \times .05 = \$4.50$ for the round trip, so that the expense of washing out would be equivalent to an increase of 33 per cent. in the cost of the water.

Sometimes it is only necessary to change the water in the boiler, in which case the cost would be about half as great, or 75 cents, as seen from our figures above.

The increase in boiler repairs due to bad water is enormous, but is seldom fully appreciated. As above referred to, some lines are able to run fireboxes for 10 or 15 years. There are other cases where they have been replaced within a year. As the cost of applying a new firebox will be between $500 and $1,000, it adds a great burden to the repair account. Again, in the Southwest, flues have been renewed regularly every 60 or 90 days, while in the East they will ordinarily run from one general repair period to another. To show what a difference in expense is caused by water, at Needles, on the Colorado river, the amount of boiler work was cut in half by the introduction of a treating plant at the principal watering point on the division. If these various items are totalized, and the interest for the time engines are out of service added to them, we will be in a position to say how much the water actually does cost, and instead of apparently costing about 5 cents per thousand gallons, it may be 10 or 15 cents.

But the most aggravating part of water trouble is caused by detentions to trains on the road. Poor steaming results from dirty boilers, as has been shown, and foaming causes delays by priming cylinders and steam chests, often causing breakage of the same. It is often necessary to close the throttle before the whistle can be sounded, and water is carried so low to prevent these difficulties, that occasionally a crown sheet comes down—if nothing worse. This is a very serious condition, but it confronts many of our Western lines to-day that have not taken up the purification of water. When these are duly considered, it will be apparent that we would be justified in going to any reasonable expense to obviate these difficulties and dangers, even to the financial disadvantage of the water department, as a judicious introduction of the proper appliances will not only reduce the cost of operation, but will give a much more satisfactory service, the value of which cannot always be figured in dollars and cents.

The Chicago & North-Western, since putting in treating plants,

has not only reduced the boiler work over 20 per cent., but has reduced engine failures 80 per cent. on its Iowa Division, which is a great indorsement for the treating system.

WASTE.

That water is usually considered an article of small value may be traced to the fact that leakage from tanks and pipes is often allowed to continue for a considerable length of time. When the staves dry out, or the tank becomes rotten, it is sometimes months before the evil is corrected. As a rule, those losses on the locomotive which have been considered in connection with the fuel, also cause waste of water. Injectors, which continually waste at the overflow, as well as leaks in boiler and tank, may be small in themselves, but when many engines are doing the same thing, a large amount of water is lost daily. This all has to be paid for in some way or other, if not by the meter, at least in fuel for pumping, and prompt steps should be taken to reduce it to a minimum.

QUANTITY.

We have now to consider the amount of water used in doing useful work, such as propelling engines and trains on levels at various speeds, up grades, around curves and any combination of two or more of these conditions. In order to obtain such figures closely to theory, we should proceed in a similar manner to our treatment of the fuel problems, by calculating the cylinder volume at cut-off, weight at cut-off pressure, and number of strokes per minute. We could then construct curves in the same way, giving the maximum capacity of the boiler and any desired fractions of this quantity. But the curves which we have already drawn for coal (see *Railroad Gazette*, March 31) indirectly show the quantity of water, as this was first determined. Thus the curve of maximum power (Fig. 2) indicating 8,000 pounds of coal per hour, may also stand for 40,000 pounds of water, as we saw that at the rate of combustion here considered, viz., $\frac{8{,}000}{3{,}200} = 2.5$ pounds per square foot of heating surface per hour, the water rate by Fig. 3 would be 6 pounds, from and at 212 degrees, and allowing the evaporative factor of 1.2, we obtain $\frac{6}{1.2} = 5$, so that $8{,}000 \times 5 = 40{,}000$ pounds of water would correspond to 8,000 pounds of coal. As the rate of combustion is reduced, the water rate increases. Thus at 6,000 pounds per hour, the rate of combustion would be $\frac{6{,}000}{3{,}200} = 1.87$ pounds, and from Fig. 3 again we find an *actual* rate of $\frac{7.2}{1.2} = 6$ pounds, or $6{,}000 \times 6 = 36{,}000$ pounds of water per hour. If we wish close figures, we have merely to proceed as outlined, but as water is perhaps always cheaper than coal (and usually very much cheaper), when considering the quantities consumed by a locomotive, it will generally be close enough to use a simpler method, and obtain approximate results.

We see from Fig. 3 that curves a, c and d lie quite close together, that is, the water rate is not very different for the three kinds of coal represented by these curves, and that for the rate of combustion usually obtaining in locomotives—from 1 to 2.5 pounds of coal per square foot of heating surface per hour—the water rate (from and at 212°) is between 6 and 9 pounds, or from 5 to 7½ pounds actually evaporated at boiler pressure. If we take the mean figure, 6¼ pounds, the greatest possible error, under the conditions which we have assumed, would be 1¼ pounds of water per pound of coal burned, or if 10 tons of coal were consumed in, say, 100 miles, the quantity of water used during this run might exceed the 6¼-pound assumption by 25,000 pounds, or, say, 3,000 gallons, which, at 10 cents a thousand gallons, would make a possible error of 30 cents in this distance. As a train-mile will cost at least one dollar, the error could not be over 3/10 per cent.—too small to notice.

This brings us to a very simple method of determining approximately the quantity of water used, viz., take it as a direct proportion of the amount of fuel. The average actual evaporation for a number of tests of simple coal-burning locomotives was ¾ gallon per pound of coal; but $.75 \times 8.33 = 6.25$ pounds of water per pound of coal, which is precisely the figure obtained above as a mean of the probable extremes observed in practice. (It is also interesting to note that the highest and lowest results of these tests were .9 and .6 of a gallon, respectively, or 7.5 and 5.0 pounds of water per pound of coal, also agreeing with our previous determination of extremes.)

From the results of a number of tests made with fuel oil in California, we may safely allow 1¼ gallons of water evaporated to a pound of the oil.

Compound engines usually show a better evaporative performance than simple locomotives for several reasons—the tests used as a reference suggest ⅞ gallon of water to a pound of coal. With oil, as there is little change in the evaporative rate, compounding should not change the constant 1.25 selected above.

When a superheater is applied, the ratio of water and fuel changes for variations in the degree of superheating, and we have tabulated the approximate water rate to be used. The constants for all the cases above considered are here repeated for convenience:

Approximate Quantity of Water Used in Gallons per Pound of Fuel.

Type.	Fuel.	Water.
Simple	Coal.	0.75, or ¾
Compound	Coal.	.84, or ⅞
Simple	Oil.	1.25, or 1¼
Compound	Oil.	1.25, or 1¼

Superheater.

Superheat.	Coal.	Oil.
100 degrees Fahr.	0.70	1.17
200 " "	.66	1.10
300 " "	.60	1.00
400 " "	.50	.83

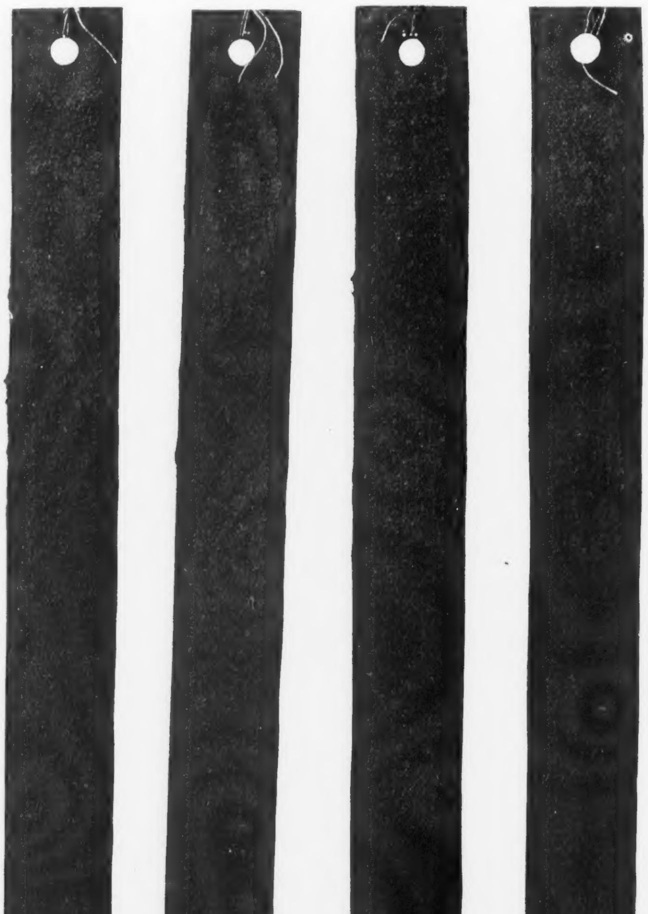
The application of these tables is so obvious that no example is necessary at this time. Later, when complete runs or trips are calculated, the effect of grade, curvature, speed, etc., will be determined for water consumption, along with the other expenses of operation.

(To be continued.)

The Paper-Process for the Protection of Iron and Steel Structures.*

BY L. H. BARKER,
Chief Assistant Engineer, Pennsylvania Railroad.

About eleven years ago experimental investigation was begun with numerous well-known and established iron paint-preservatives, in order to ascertain by actual exposure tests the best one to resist the destructive action on steel structures of sulphurous gases in the form of smoke combined with the moisture of steam, and since that time 50 or more paints and combinations have been tried. Among them were many kinds of asphaltum, rubber, graphite, carbon lead and iron paints, and though the results showed varying degrees of resistance, it is remarkable that even with three coats of paint not one was found that did not show rust in less than a year. Of course, it is to be understood that the exposures were



Experimental Bars Exposed Eight Months. Upper Half Coated with Three Coats of Paint, Lower Half Coated with Paper Process.

*From a paper read before the American Society for Testing Materials, Atlantic City, June 30, 1905.

made so as to subject the test bars to the severest action possible in order to obtain the quickest results.

In making the first series of tests new steel plates 10 in. square were used. As, however, the adverse conditions we were trying to overcome related to rusty steel, which is more difficult to preserve than new steel, rusty plates were substituted in all tests thereafter. To still further endeavor to meet the existing conditions new plates were hung up and exposed to the smoke fumes until they became covered with sulphur scale. The thought being that an oxide scale due to atmospheric exposure might give different results. This scale or rust formation on these new plates apparently varied not only in amount, but also in the time of its formation, supposedly due to different chemical composition. As this might again give some variations in the experimental results, in order that all paints should be on as like footing as possible, angle bars 11 ft. long were made use of and as before hung in the smoke until rusted, then cleaned with wire brushes, each foot of the bar painted with a different paint and again hung up. The results, however, continued to be unsatisfactory.

In examinations of the test bars from time to time it was seen that upon many of them the paint was intact, but with protruding points which upon being pricked were found to be small rust formations pushing up the paint from behind, clearly indicating that it was not the failure of the paints but the rust action on the inner surface that caused the damage. As no rust can form without the presence of moisture, and as all paints are pervious to moisture (as Dr. Dudley's careful investigations of the subject have proved) this led to the conclusion that it would be necessary in some way to tightly seal the surface. Many kinds of materials for doing this were tried, with as many different results, until three years ago it was decided that a cheap paraffine paper answered the purpose best of all and since that time all experimentation has been along that line. The few test bars shown in the accompanying illustration indicate the results. The paper covering has been tried in a small practical way against smoke action, and after two years and three months exposure an examination showed the outer paint, the paper and the first or adhesive coat all intact and in many places where paper was removed for examination the adhesive coat not yet dry and the surface of steel the same as when painted. With such satisfactory results from this paper-process in the smoke tests, it was concluded to make a large-scale application and severe test on a large number of eye beams supporting a floor over and within a few feet of salt water and upon which the rust was due not to smoke but to the almost continuous dampness and presence of sewer gases. This was done over a year ago and up to this time indication of damage of no kind is apparent.

The mode of application of the paper is as follows: After the rust is carefully cleaned off by means of stiff wire brushes, a certain kind of tacky paint is applied, the paper then covered over and tightly pressed upon the painted surface, the joints of the paper slightly lapping. As soon as the paper is in place, it is ready for the outside coat of paint. It will be observed that by this process, the first coat of paint, the paper and the coat of paint over the paper can be applied with one scaffolding, thereby greatly reducing the cost, especially in high and dangerous places.

These experiments, extending over only three years, are of too short a duration to determine the value of paper as a protection for iron and steel, but they certainly bring out the fact, at least in the case of smoke and gases, that the action begins from behind the paint and not from in front by the disintegration of the paint.

Train Accidents in the United States in June.[1]

unf, 1st, 11 p.m., Southern Pacific, Sulphur, La., passenger train No. 8 was derailed by running over a cow and the engineman and fireman were badly scalded.

*o, 1st, Pennsylvania Lines, Stillwater Junction, Ohio, passenger train No. 28 struck an oil wagon at a crossing, tearing open the oil tank and spreading the oil so that it was ignited by the fire of the engine; and the engineman and fireman were burned to death.

eq, 2d, Delaware, Lackawanna & Western, Passaic, N. J., a freight train was derailed by a broken axle and 12 cars were wrecked. A trespasser riding on the train was killed.

bc, 5th, Pennsylvania road, Newport, Pa., collision between a passenger train and a freight train, wrecking three engines, four freight cars and two express cars. Three passengers and three trainmen were injured.

unf, 6th, Pere Marquette, Ionia, Mich., a freight train was derailed at a washout; the engineman and fireman were killed and two brakemen were injured.

unx, 6th, Norfolk & Western, Bedford, Va., a freight train drawn by two engines was derailed, and both engines and 17 cars fell down a bank. One fireman was killed and four tramps were injured.

unx, 6th, San Pedro, Los Angeles & Salt Lake, Caliente, Nev., a special passenger train, heavily loaded, was derailed, and three passengers were injured.

dn, 6th, Grand Trunk, Pewamo, Mich., an extra engine was derailed at a washout and the engine, four cars and a pile driver were wrecked. Six employees were killed and one fatally injured. It is said that the extra engine had been properly flagged but that the flag was not heeded.

unf, 7th, Wisconsin Central, Colfax, Wis., passenger train No. 1 broke through a bridge, the center span of which had been undermined by a flood, and the engine and first two cars fell into the river. The engineman, fireman and five tramps were drowned.

†dr, 8th, Grand Trunk, Davison, Mich., passenger train No. 3 was derailed by spreading of rails and three cars were ditched. Eleven passengers were injured, one of them fatally.

bc, 9th, Texas & New Orleans, Athens, Tex., butting collision of freight trains, wrecking both engines and several cars. One engineman was scalded to death and one fireman was killed by being buried under coal.

dr, 10th, 2 a.m., Southern Railway, Del Rio, Tenn., passenger train No. 35 was derailed by a defective rail or switch, and four passenger cars were overturned. One passenger was injured.

xc, 10th, Mobile & Ohio, Pritchards, Ala., collision between a freight train and a switching engine; one engineman killed.

o, 10th, New York, New Haven & Hartford, Wollaston, Mass., the locomotive of a freight train was wrecked by the explosion of its boiler, and a brakeman was injured. The explosion was severe, yet the engineman and fireman escaped without serious injury.

unf, 10th, 3 a.m., Chicago, Burlington & Quincy, Farnam, Neb., a freight train drawn by two engines was derailed at a washout, and the second engine was ditched. One fireman was killed.

dn, 12th, Central of New Jersey, Dover, N. J., a freight train which had become uncontrollable on a descending grade ran into an open drawbridge at the Morris canal, wrecking the bridge and badly damaging two cars and a canal boat. A child sleeping in the cabin of the boat was injured.

bc, 13th, Albany & Hudson, East Greenbush, N. Y., butting collision between a passenger train consisting of one electric car, and a special train consisting of one motor car and one car loaded with horses. One passenger was injured. The collision is said to have been due to a misunderstanding of orders.

unx, 13th, Southern Railway, Georgetown, Ind., a freight train was derailed and five cars were ditched. Three trespassers were injured, one of them fatally.

unx, 13th, Southern Railway, Golden Gate, Ill., a special passenger train was derailed on a bridge and four cars fell down into Little Wabash river. The engineman and fireman were killed and 10 passengers were injured.

dr, 14th, Southern Pacific, Mescal, Ariz., a passenger train was derailed at a defective switch and the engine and several cars were wrecked. Three tramps were killed and a mail clerk was injured.

unx, 14th, Mobile & Ohio, Selmer, Tenn., a freight train was derailed and the engine was overturned; engineman killed.

15th, Boston & Maine, Walpole, N. H., passenger train No. 12 was derailed at a defective or unfastened switch, and the engine fell down a bank, followed by the mail car. The engineman and two other trainmen were injured.

unx, 15th, Central of New Jersey, Wilkesbarre, Pa., the engine of a passenger train was derailed and overturned and the fireman was injured.

unx, 15th, Southern Railway, Kings Mountain, N. C., the engine and first two cars of passenger train No. 40 were derailed, and the engine was ditched. The engineman and fireman were injured, the latter fatally.

*bc, 16th, Pennsylvania Railroad, Wilcox, Pa., butting collision between westbound freight train No. 97 and eastbound freight train No. 80, wrecking both engines and several cars. The wreck took fire and three cars of oil and 12 other cars were burnt up. One fireman and a trespasser were killed and three trainmen were injured. It is said that the watch of one of the enginemen was 10 minutes slow, and that this was the cause of the collision.

xc, 16th, Birmingham, Ala., collision between a passenger train of the Louisville & Nashville and a locomotive of the Central of Georgia, at a crossing of the two roads. Fourteen employees were injured, most of them being passengers in the passenger train riding to their work.

bc, 17th, Western Maryland, Patapsco, Md., butting collision between westbound passenger train No. 5 and an eastbound freight train drawn by two engines. All three of the engines, the leading cars of the passenger, and many cars of the freight were wrecked. On the passenger train was a large gang of roadway employees and many of the men were sitting on the steps of the cars: 18 of these employees and eight trainmen were killed, and four trainmen, 13

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[1] Accidents in which injuries are few or slight and the money loss is apparently small, will, as a rule, be omitted from this list. The official accident record, published by the Interstate Commerce Commission quarterly, is regularly reprinted in the *Railroad Gazette*. The classification of the accidents in the present list is indicated by the use of the following

ABBREVIATIONS.

rc	Rear collisions.
bc	Butting collisions.
xc	Miscellaneous collisions.
dr	Derailments: defects of roadway.
eq	Derailments: defect of equipment.
dn	Derailments: negligence in operating.
unf	Derailments: unforeseen obstruction.
unx	Derailments: unexplained.
o	Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more passengers.

laborers and three passengers were injured. The men in charge of the freight train had overlooked the schedule of the passenger train.

xc, 17th, Chicago & North-Western, Gilbert's, Ill., collision between an eastbound passenger train and a westbound freight; passenger engineman fatally injured. It is said that the collision was due to a misplaced switch.

xc, 17th, Boston & Albany, West Pittsfield, Mass., a car in a westbound freight train was derailed and fell in front of an eastbound passenger train, badly damaging the engine and two passenger cars. The engineman and fireman of the passenger were severely scalded.

unf, 17th, Baltimore & Ohio, Philadelphia, Pa., the engine and baggage car of a fast passenger train were derailed and wrecked by a plank which had been thrown upon the track, immediately in front of the train, from an overhead bridge, by mischievous boys. Three persons were injured. The engine ran against a signal tower, wrecking it and injuring two men inside.

unx, 17th, Gulf, Colorado & Santa Fe, Rogan, Tex., a passenger train consisting of nine cars, carrying 317 passengers, was derailed and a porter was fatally injured.

unx, 18th, St. Louis & San Francisco, Oklahoma City, Okla. T., the tender of the locomotive of a passenger train was derailed and, with the baggage car, was wrecked. The engineman and fireman were killed.

eq, 18th, Chesapeake & Ohio, Maysville, Ky., a passenger train was derailed by a broken flange and four passengers were injured.

o, 19th, New York Central & Hudson River, St. Johnsville, N. Y., the locomotive of a freight train was wrecked by the explosion of its boiler, and the fireman and one brakeman were badly scalded.

bc, 20th, 3 a.m., New York, New Haven & Hartford, Newington, Conn., butting collision between an eastbound freight and an empty engine westbound, making a bad wreck. Both firemen and one brakeman were killed and both enginemen were injured, one fatally.

xc, 20th, Louisville & Nashville, Middlesboro, Ky., a freight train broke in two and the rear portion afterwards ran into the forward one, wrecking four cars. The conductor was killed and one brakeman injured.

unx, 20th, Northern Pacific, Seattle, Wash., a switching engine was derailed and the foreman of the crew with his stepdaughter, who was riding in the engine with him, were killed, and the yardmaster was injured.

xc, 21st, Philadelphia & Reading, Locust Summit, Pa., an inspection engine collided with a yard engine and was badly wrecked. The engineman, fireman and two physicians riding on the inspection engine were injured.

*†21st, 9 p.m., Lake Shore & Michigan Southern, Mentor, Ohio, the eastbound Twentieth Century Limited express, running at high speed, was derailed at a misplaced facing-point switch and the engine and first car (a combination baggage and smoking car) were wrecked. The engine fell against the freight house; this building took fire, and, with a good part of the wreck was burnt up. Fifteen passengers and four trainmen were killed and 15 passengers and trainmen were injured. All of the passengers killed were in the first car (the smoking car). This accident was reported in the *Railroad Gazette* of June 23 and 30.

dr, 22d, 3 a.m., Denver & Rio Grande, Thomson Springs, Utah, westobund passenger train No. 5 was derailed by a broken frog and the baggage car and three passenger cars were ditched. Six passengers were injured.

bc, 23d, Louisville & Nashville, Appalachia, Tenn., butting collision of freight trains, badly damaging both engines and several cars. One trainman was killed and two were injured.

dr, 23d, 4 a.m., Seaboard Air Line, Santos, Fla., a sleeping car at the rear of a passenger train was derailed and overturned at a defective switch. The conductor and three passengers were injured.

unf, 23d, Richmond, Fredericksburg & Potomac, Summit, Va., a freight train was derailed at a washout, making a bad wreck. Two tramps were killed.

dn, 24th, Chicago, Rock Island & Pacific, Iowa City, Iowa, a passenger train was derailed at a misplaced switch and the engine and first two cars were overturned. The engineman was killed and the fireman injured.

unx, 25th, West Jersey & Seashore, Sea Isle Junction, N. J., an excursion passenger train was derailed and the engine and one passenger car were ditched. The fireman was injured.

†rc, 26th, Illinois Central, Vine Grove, Ky., northbound passenger train No. 122 was run into at the rear by following freight train No. 14, and the three rear cars of the leading train (a dining car and two passenger cars) were wrecked. Three passengers were killed and 12 injured. The passenger train was running about six miles an hour when it was struck. The freight train had been running at the rate of 25 miles an hour.

xc, 27th, Pennsylvania Lines, Lima, Ohio, an eastbound passenger train ran over a misplaced switch, colliding with a switching engine on the side track; four employees were injured, one fatally.

xc, 27th, Atchison, Topeka & Santa Fe, Castle Rock, Colo., a freight train ascending a steep grade broke in two and the rear portion, consisting of 33 cars, ran back down hill and into the head of a passenger train of the Colorado & Southern, wrecking the passenger engine. The fireman of the freight was killed and many passengers were injured.

unf, 28th, Illinois Central, Patoka, Ill., a freight train was wrecked by running into a washout, and the engineman was killed. The fireman was seriously injured.

bc, 29th, 1 a.m., Buffalo, Rochester & Pittsburg, Oscar, Pa., butting collision of freight trains, wrecking both engines and five cars. One engineman was killed and three other trainmen were injured. There was a dense fog at the time. It is said that the southbound train had passed a red signal set against it at Echo.

xc, 29th, 3 a.m., Union Pacific, Ellis, Kan., collision between passenger train No. 101 and a freight which was entering a siding but had not cleared the main track; the engineman of the passenger and two trespassers were killed.

†xc, 29th, Atchison, Topeka & Santa Fe, San Antonio, N. Mex., a northbound passenger train collided with some freight cars which had been accidentally run from a siding on to the main track, and one passenger car was wrecked. One passenger was killed and several were injured.

xc, 29th, Atchison, Topeka & Santa Fe, Kansas City, Mo., collision between a passenger train and a freight; two trainmen killed; two trainmen and one passenger injured.

unx, 29th, Pennsylvania Lines, Atwater, Ohio, an eastbound passenger train running at high speed was derailed and ditched, and the engine and several cars were wrecked. One passenger was killed and several persons were injured.

bc, 30th, Central Vermont, Monson, Mass., a southbound freight standing at the station was run into in front by a northbound freight approaching on a descending grade at uncontrollable speed, both engines and several cars were wrecked. One fireman was killed.

eq, 30th, 11 p.m., Queen & Crescent, Jackson, Miss., an eastbound passenger train was derailed by the breaking of the flange of a wheel of the engine, and the engine and three cars were badly damaged. Seven trainmen were injured.

unx, 30th, Texas & Pacific, Longview, Tex., a car in a freight train was derailed on a high bridge and, with two other cars, fell 60 ft. to the stream below. Two men were killed.

A New Plan for Operating Street Railways in Chicago.

A few weeks ago we discussed editorially Mayor Dunne's proposal of municipal ownership for the Chicago street car lines, and expressed the belief that such a plan was inadvisable in Chicago. This point of view has received rapid confirmation in a message addressed to the Chicago City Council week before last, in which the Mayor abandons any attempt at securing immediate municipal ownership, but offers a contract plan as a substitute. The Council has not yet given this plan consideration, but has adjourned until September 25, so that nothing can be done in the meantime. The plan proposed is printed below in abstract:

1. The incorporation of a company under the laws of Illinois by five persons possessing the confidence of the people, for their personal integrity, their business ability, and their pronounced sympathy with the policy of municipal ownership of street-car service. This company to be incorporated for the express purpose of building, acquiring and operating street-railroad lines in Chicago in the interest of the city, and to have the power to issue capital stock to secure the money necessary. The capital stock to constitute the only incumbrance upon the property, and its amount to be limited to the actual cost of the property. Dividends upon the capital stock to be limited to 6 per cent. per annum.

2. The granting by the city council to such company of duly guarded franchises on designated streets between fixed termini for a period of 20 years, at 5 cents car fare, with appropriate transfers, and with a reservation on the part of the city of the right to take over all or any part of such road, at any time, at the price and upon the terms to be contractually specified in execution of this plan.

3. The directors, president and manager of the company to be compensated, until the city takes over the property, with salaries to be approved by the city council.

4. All expenditures, contracts and specifications for the building, or other acquisition of street railroad properties by the company to be approved by the city council before being incurred or executed by the company.

5. During the operation of the lines by this company the city council to have the right at all times fully to inspect its business, and also to reduce fares below the franchise rate to the extent of one half the net earnings of the property, in excess of operating expenses and dividends; all net earnings to be set aside as a purchase fund for the acquisition of the property for the city, or to be used in the betterment of the property, as the city council may from time to time direct.

6. In order to secure to the directors the control of the property and to preserve to the city the unobstructed right at any time to acquire such property in accordance with this plan, the capital stock of the company should be issued in trust to a trust company, to be selected by the directors, with the approval of the city council, which trust company should issue on the basis thereof an equal amount of marketable trust certificates to the company for the purpose of obtaining capital by sale thereof, and hold the capital stock in trust to preserve the control of the aforesaid trustees for the management of the said street-car lines and the consummation of this plan for securing municipal ownership and operation.

The said trust company should be required to sell the stock of the said company, as represented by said certificates, by public subscription, duly advertised. In the event of over subscription it should be required to make allotments in the order of the receipt of subscriptions. In the event of undersubscription the directors should be authorized to contract for the underwriting of the entire offering at a cost not to exceed 2½ per cent., and the chosen trust company and any of the directors should be at liberty to become underwriters.

7. Upon the payment to the aforesaid trust company by the City of Chicago of an amount equal to the cost of the property less the accumulated amount of the sinking fund hereinabove provided for the said trust company should be required by the preliminary contracts to use said sum so paid, together with said sinking fund, in such way as to redeem all outstanding certificates issued by it, upon the security of the capital stock of said proposed street-car company, and to use the said capital stock held by it in trust in such way as to transfer all the street railroad property of the said street-railroad company immediately to the City of Chicago, for direct municipal ownership and operation.

Railroad Shop Tools.

(Continued.)

LATHES.

The accompanying illustration, Fig. 1, shows a new 16-in. engine lathe made by the Fosdick Machine Tool Company, Cincinnati, Ohio, as fitted with compound rest and Emmes' patent feed box. These machines are made in 6 ft., 8 ft., 10 ft. and 12 ft. lengths, with cabinet or regular legs, and can also be fitted with oil pans when desired. The spindle bearings are 2¾ in. and 2⅛ in. in diameter and a 1¼ in. hole is provided in the spindle. The spindle bearings are bushed with bronze and constant lubrication is provided by an endless chain and large oil pockets. The machine is strongly made and if desired a three-step driving pulley may be used in place of the five step cone, thus insuring a more powerful spindle drive as required for high speed steel work. The carriage has wide and long bearings on the shears and the apron is of box section, which insures strength and stiffness. The taper attachment is of an approved design and is easily applied. All screws necessitating adjustment can be operated by the tool post wrench. The general dimensions of the 16-in. machine shown in the illustration are as follows: Swing over bed 16¼ in.; swing over carriage 10¼ in.; 6 ft. bed takes 34 in. between centers; face of five-step cone pulley 2⅝ in.; face of three-step cone pulley 3⅜ in.; weight 2,000 lbs. Friction counter shafts are furnished with each machine. These are provided with self-oiling bearings and the friction pulleys are provided with large oil wells. The counter speed for five-step cone is 120 r.p.m. and for the three-step cone 250 r.p.m.

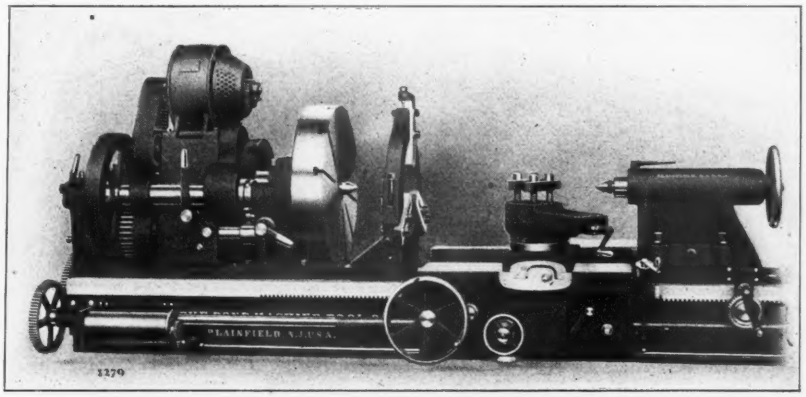


Fig. 2—Niles-Bement-Pond 42-in. Engine Lathe.

The 42-in. engine lathe shown in Fig. 2 is made by the Niles-Bement Pond Company, New York. This machine is driven by a 15 h.p. motor, which is controlled by a handle attached to the lathe carriage. The motor has a slight speed variation by means of field control. The machine will swing 43 in. over the bed and 34 in. over the carriage, and fitted with a 16-ft. bed it will turn 7 ft. between centers. The spindles are of hammered steel and the face-

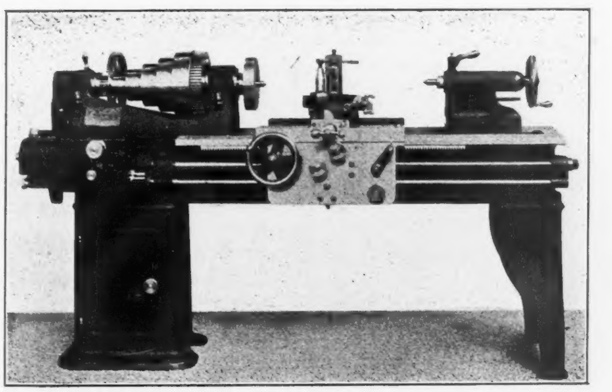


Fig. 1—The Fosdick 16-in. Engine Lathe.

plate spindle is mounted in bronze bearings. The tailstock has a set over for taper turning and is adjusted by gearing engaging in the steel feed rack, as shown. The bed is made wide, so that the tool-slide will not overhang when turning the largest diameters. The carriage has long bearings on wide flat tracks, but if desired V tracks can be furnished. It is gibbed to the outside edges of the bed and can be securely clamped in position when cross feeding. It is provided with a tool-slide having compound swiveling movements; also with screw-cutting attachment and automatic-friction longitudinal and cross-feeds. If either of the feeds or screw cutting attachment is in use it locks out all the others. The direction of the feeds can be changed at the carriage and the screw-cutting attachment and the feeds are connected to the live spindle by three gears and a sliding-key, giving three changes without changing gears. The carriage-gearing is driven by a spline in the steel lead-screw, the thread of the lead-screw being used only for screw cutting. The gear engaging the feed rack can be disengaged when cutting screws, thus preventing any uneven motion that might be caused by revolution of the feed-gearing.

PLANERS.

Fig. 3 shows a 36-in. x 36-in. switch and frog planer made by the G. A. Gray Company, Cincinnati, Ohio. This machine was designed for the heaviest kind of switch and frog work and its characteristic features are its great power, weight and stiffness. The bed is 2 ft. deep, and is strongly cross-ribbed by box girders. The table is 32 in. wide and is gibbed underneath, both on the front and rear sides, to prevent direct lifting. In addition to the gibs the table is provided with vertical inside bearings extending its entire length. These counteract the side thrust, thus making it impossible to lift the table even under the heaviest cuts. The housings are of box form and are 10 in. wide at the cross rail bearing, thus giving ample rigidity to resist the strain of the side tools which are used almost exclusively in frog and switch work. The cross rail is 18 in. wide, and in addition to being very deep and stiff is "double-gibbed"; that is, it is fastened to the housings not only by the regular set of gibs, which grip the housings at the outside, but also by an additional set of gibs, which are bolted to the inside flanges. The cross rail elevating gear is provided with ball-bearings, thus insuring ease in operation. The saddles are made right and left-handed and each has a bearing of 24 in. on the cross rail. The tool boxes are 11 in. wide and are provided with two steel clamps and 1¼ in. bolts for holding the tools. A positive locking device is attached to the shifter-lever, which prevents the belts from accidentally starting the table. The gearing and rack are of crucible steel, cut from the solid. The bull-wheel and rack are 9 in. face and 2 in. pitch. The pulleys are of large diameter and wide face and the locking pulley as regularly furnished gives a quick return of 4 to 1. The automatic feeds are all positive and independent in action. Conical

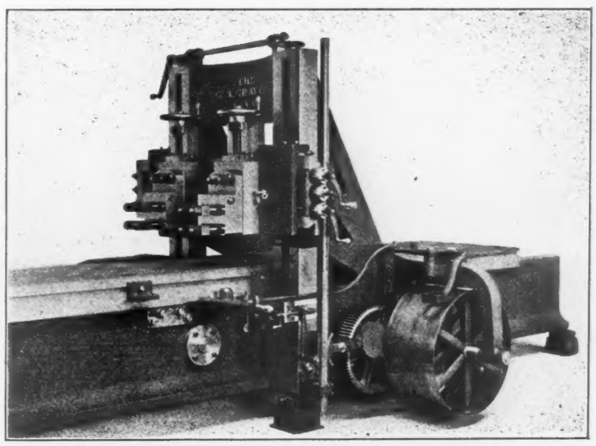


Fig. 3—The G. A. Gray Co.'s Special Switch and Frog Planer.

rollers keep the Vs well oiled and all oil holes are threaded and covered with brass knurled-head plugs. This machine is self-contained, thus no expensive foundation is required, as there are no outside bearings requiring independent support. These machines are made in lengths from 8 ft. to 20 ft.

(To be continued.)

Tests of Riveted Joints.*

The Committee on Iron and Steel Structures appointed by the American Railway Engineering and Maintenance of Way Association made extensive tests of riveted joints with a view to ascer-

*Extract from Bulletin No. 62, issued by the American Railway Engineering and Maintenance of Way Association, April, 1905.

taining their behavior under strain. The material used for the plates and rivets which were tested was basic open hearth steel of a quality in accordance with the specifications for materials adopted by the Association. The rivet holes were punched with a punch $^{15}/_{16}$ in. in diameter in a die 1 in. in diameter. No reaming was done before the rivets were driven, except such as was necessary to get fair holes. The contact surfaces were painted with graphite paint and the rivets had a diameter of $\frac{7}{8}$ in. before they were driven. They were driven with a stationary pressure riveter operated by compressed air, direct, during the first part of the stroke of the up-setting tool, and by compressed air acting on a piston in an oil chamber back of the up-setting tool toward the end of the stroke, exerting a pressure of about 70 tons on the rivet. Five specimens of 18 types of joints were tested, making 90 specimens in all. The specimens were furnished by the North Works of the Illinois Steel Company and the tests were made by the College of Civil Engineering, Cornell University. From the observations and results of these tests the following conclusions were drawn by the committee:

(1) That the resistance of a riveted joint against deformation by shearing forces, up to the yield point, is due to the friction between the surfaces held in contact by the rivets.

(2) That the yield point of a riveted joint is reached when the shearing forces are equal to the friction of the surfaces held in contact by the rivets.

(3) That the deformation of a riveted joint at the yield point is caused by the slipping on each other of the surfaces held in contact by the rivets, and is due to the diametral contraction of the rivets in cooling after they are driven, which leaves a space between the body of the rivet and the edge of the rivet hole.

(4) That after the slip at the yield point has occurred and the rivet is brought to bear against the edge of the rivet hole, a deformation of the body of the rivet takes place with an accelerating increase in the resistance until the entire side of the rivet has been brought to bear against the edge of the rivet hole, and that the deformation continues beyond this point with a diminishing increase in the resistance until the ultimate strength of the rivet in shear has been reached and the breakdown occurs.

(5) That lap joints, on account of the unsymmetrical distribution of the material, deflect sideways under strain, throwing the rivets in tension, and thereby reducing the shearing forces between the surfaces held in contact by the rivets.

(6) That fillers inserted between the main plates reduce the strength of a riveted joint, but that the full strength can be obtained by connecting the fillers to the main plates by additional rivets.

(7) That the number of rivets connecting the fillers to the main plates should, for each intervening filler, be about one-third of the number of rivets required in a similar joint without fillers, to obtain the same strength in both cases.

(8) That the strength of a riveted joint with rivets of larger grip than about four times their diameter is decreased, as the length of the grip is increased.

(9) That the number of rivets, in a riveted joint with larger grip of the rivets than four times their diameter, should be increased at least 1 per cent. for each one-sixteenth of an inch increase in the grip above this length, to obtain the same strength as a similar joint with the grip of the rivets shorter than four times their diameter.

(10) That a riveted joint, subject to forces always acting in the same direction, may safely be strained beyond the yield point up to a point where the rivets are brought to bear against the edges of the rivet holes.

(11) That a riveted joint, subject to forces alternating in opposite directions, may not safely be strained up to the yield point.

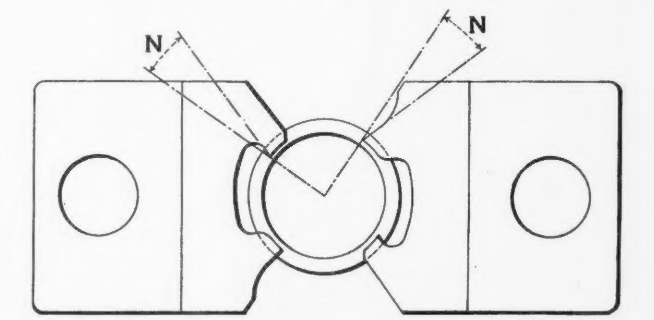
(12) That, to obtain a minimum slip at the yield point, it is necessary that the holes in the component pieces should thoroughly match and that the driving tool should upset the rivet throughout its length so that it will thoroughly fill the rivet hole.

Obstacles to a Mexican Trans-Continental Line.

In spite of the influx into Mexico of American capital and engineers and the large developments which have resulted, there is as yet no railroad line in Mexico north of Mexico City which connects the Gulf of Mexico with the Pacific Ocean. The Mexican Central and the National Lines of Mexico furnish satisfactory north and south connections between the United States and the most important cities of Mexico, including the two principal ports on the Gulf, Tampico being reached by the Mexican Central and Vera Cruz by the National Railroad of Mexico. But the difficulties of getting to almost any point on the Pacific Coast are very great. The railroad journey, for instance, from Guaymas, on the Gulf of California to Chihuahua, distant 275 miles by an air line, is 1,033 miles long. One must go straight north from Guaymas by the Southern Pacific's Sonora Railroad to the Southern Pacific main line in Arizona, then travel east over the Southern Pacific through Arizona and New Mexico to El Paso, Tex., and from El Paso go south again 363 miles by the Mexican Central to Chihuahua, the capital of the state of Chihuahua. This is going around three sides of a square instead of one. It is therefore likely to be an easier and quicker trip to traverse by pack mule the 275 miles east from Guaymas over the plateaus and mountains to the inland capital. The tremendous difficulty of crossing the Sierra Madre mountains, which stretch practically the length of the country from 70 to 250 miles east of the Pacific coast, has heretofore prevented the building of a transcontinental line in northern Mexico. The Mexican International not long ago built an extension to the city of Durango in order to tap the rich mining country in that province. This road was built up to the edge of the Sierras, but as yet there have been nothing further than surveys for its direct extension to the Pacific. This, however, is understood to be the ultimate intention of the company. Instead of keeping on directly west the road as built turned sharply to the northwest at Durango and ran to Tepehuanes in another important mining district in Durango province. By building an air line less than 125 miles long from Tepehuanes through the mountains to meet the line of the Western Railway of Mexico, which runs from Altata on the Pacific Coast 38 miles inland to Culiacan, the Mexican International would reach the Pacific. This connection it is practically out of the question to build, as at this point the mountains are so high that the grades would be prohibitive. Nor can these grades be avoided by tunneling unless the company is willing to build tunnels for almost the whole distance, which would of course make the line far too expensive to be practicable. In the south, directly west of the City of Mexico, the Mexican National Construction Company's line runs from Manzanillo, on the Pacific Coast of the province of Jalisco, to Colima. The Mexican Central now has an option on this road whose terminus, Colima, is only about 40 miles distant from Tuxpan, the end of the Mexican Central's Zapotlan branch. Contracts are reported to have already been let by the Mexican Central for filling in this gap and if the option on the Construction Company's line is exercised, that road will soon have a through line from the Atlantic to the Pacific Ocean. In the north it looks as though the Kansas City, Mexico & Orient, which has taken over the Chihuahua & Pacific, would furnish the connection for the first trans continental line. The Chihuahua & Pacific runs in a general southwesterly direction from Chihuahua to Minaca, and the Kansas City, Mexico & Orient is to run in the same general direction from Presidio on the Texas border to Port Stilwell (Topolobampo) on the Pacific coast south of Guaymas. The road is in operation from Topolobampo northeast to El Fuerte, 62 miles, and construction is under way on several other parts of the line. Thus, in spite of all the difficulties of mountain railroad building which lie in the way of a Mexican railroad to the Pacific, there are several projects under way to build such a line, and it seems pretty certain that before many years there will be more than one rail connection through northern Mexico between the two oceans.

Cutting Threads on Steel Pipe.

Since the introduction of modern weldable Bessemer steel for pipe considerable trouble has been experienced in cutting satisfactory threads on it. The National Tube Company, Pittsburg, Pa., investigated the matter with a view to finding the cause of the above trouble. After much experimenting the die department of the company found that the trouble was largely due to insufficient rake and clearance being given to the threading of dies. Without the proper rake and clearance the thread is ragged and torn and the tool wears quickly. There are also other points peculiar to the construction of threading dies which have to do with the results obtained, but all things being considered it was found that the angle of rake (N in the sketch) is the point which has most



Modified Form of Armstrong Threading Die.

to do with efficiency, and is also the feature which is generally overlooked in the tools commonly supplied to the trade. A properly designed die is particularly necessary for threading soft steel pipe, but at the same time a correctly shaped die will work to better advantage on iron pipe than one improperly made, as truer threads and consequently tighter joints will be the result as well as lower cost of threading and less damage to the pipe and dies. A die to work properly and to give a clean true thread must have the proper amount of rake, as shown in the illustration; the chasers must be rigidly held and controlled close to the work with a due regard to chip room, and sufficient lubricating oil must also be employed. The following angles between a line through the center of the pipe and the cutting face of the chaser at the point of contact with the pipe, are given by Frank N. Speller, Metallurgical Engineer, of the National Tube Company, to whom we are indebted for the above information, as giving the best results in practice.

Size.	Angle N.	Size.	Angle N.	Size.	Angle N.
1-inch....	26 degrees.	4-inch....	23 degrees.	10-inch...	20 degrees.
2-inch....	25 "	6-inch....	22 "	12-inch...	18 "
3-inch....	25 "	8-inch....	20 "		

GENERAL NEWS SECTION

NOTES.

On June 29 the Twentieth Century Limited was run from Toledo to Elkhart, 133 miles, in 1 hr. 52½ min., equal to 70.93 miles an hour.

The schedules of the 18-hour New York-Chicago trains of the Pennsylvania have been slightly changed, but without altering the time through. The change was made principally to accommodate the dining car department.

It is announced that the merchants of Chicago who have been asking the Illinois State Railroad Commission to reduce freight rates have withdrawn their petition, the railroads having agreed to make reductions, from Chicago to the principal points in the state, averaging 32 per cent.

The officers of the Voluntary Relief Department of the Southwest System of the Pennsylvania Lines West of Pittsburg recently elected for the ensuing year are: Division 1, Charles D. Alexander; Division 2, John Haley; Division 3, Geo. M. McManigal; Division 4, Wm. J. Merrick; Division 5, Matthew J. Purcell; Division 6, Edward W. Alexander; Division 7, Theo. H. Haberkorn; Division 8, Wm. T. Brown.

In the Georgia Legislature a bill has been introduced by Mr. Parker, of Appling County, to make it a misdemeanor for any railroad to carry passengers on the Sabbath for less than the regular fare; or, in other words, it is proposed to forbid cheap excursions on that day. A railroad officer, interviewed on the subject, says that such a law would not cause great sorrow on the part of the railroads, for they have become somewhat tired of Sunday excursions, believing that they do not increase the total income from passenger traffic.

The General Superintendent of Transportation of the Baltimore & Ohio has prepared an elaborate map of the lines of the company, and of connecting lines, to enable superintendents to quickly decide what route should be selected for detouring trains when a main line is obstructed. With the map are recorded all necessary data concerning the limitations of the roundabout lines, as regards the weights that the track and bridges will sustain, and the other conditions necessary to be taken into account in sending a train out of its ordinary path.

The Kentucky Railroad Commission holds that under the constitution of that state the express companies are common carriers as well as the railroad corporations, and that it is within the province of the commission to regulate the rates where charges are made that the rates are exorbitant. The case arose when the city of Shelbyville levied a license tax of $25 a year upon the Adams and Southern express companies, and they retaliated by adding one cent to the charge on each package in and out of town at certain times during the year.

Complaints have been filed with the Interstate Commerce Commission by the National Wholesale Lumber Dealers' Association against the roads east of the Mississippi river, charging that the railroads discriminate against lumber interests in that an allowance for racking on gondola or flat cars given to shippers of other commodities is denied to shippers of lumber. It is claimed by the Lumber Association that the same character of rack is used for the shipment of lumber that is used for the shipment of many other commodities and that lumber shippers should receive the same allowance.

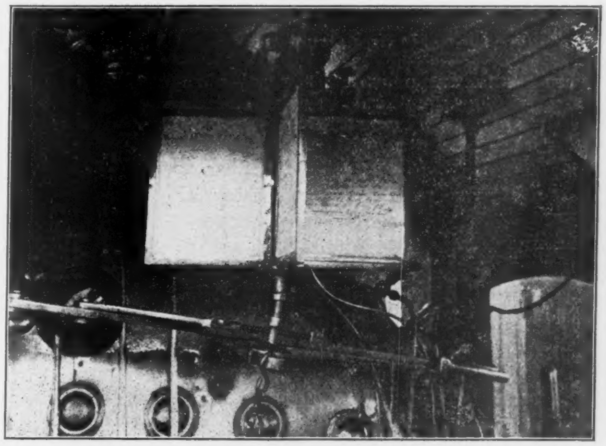
The special train which was run over the Pittsburg, Fort Wayne & Chicago from Chicago to Pittsburg on June 8 preparatory to the establishment of the 18-hour schedules, traversed the distance from Clarke Junction to Fort Wayne, 125 miles, in 101 minutes. This is equal to 74.25 miles an hour, or 4.25 miles an hour higher than the rate made by the Lake Shore special trains, of June 12 and 13, over the 133 miles between Elkhart and Toledo. The Pennsylvania run was made by Atlantic type engine 7,167, Class E2a. The weight of the train was 140 tons, or about 35 tons less than that of the Lake Shore train. The engines of the two roads are pretty nearly alike as regards power. Their principal dimensions were given in the *Railroad Gazette* of June 30, in connection with the record of the Lake Shore train.

On July 15 the eastbound 18-hour train on the Pennsylvania met with an accident near Port Royal, Pa., which narrowly escaped being a very serious one. According to press despatches the engineer of a westbound freight train near Port Royal made too violent an application of his air, with the result that a car buckled and was thrown over on the track on which the eastbound 18-hour train was running. An attempt was made to flag trains in front and in the rear of the wreck, but the break occurred almost simultaneously with the arrival of the fast train, which hit the wrecked car and threw it from the track without sustaining injury. The engineer of the fast train jumped from his engine and was hurt. No one else was injured, and the passengers, who were in their berths at the time, are said not to have known that there had been an accident until afterwards.

The Italian government announced only on June 15 the organization with which it was to begin the working of the railroads of the country July 1. The head of this organization is a General Manager (Bianchi), supported by an Executive Council of six other members, of whom one has been chief inspector of the treasury department, and another (Luiggi) is an eminent engineer, known best for a great naval harbor which he designed for Argentina in competition with English, French and German engineers, and which was built under his direction at Bahia Blanca. The direct operation of the lines will be managed from eight offices, one each in Turin, Milan, Genoa, Venice, Florence, Rome, Naples and Palermo. As there are just about 10,000 miles of railroad in the country, including some short lines not owned by the state, this gives about 1,200 miles, on the average, to each superintendency, each of which will have its own secretary, accounting office, chief of transportation and traffic, train movement and stores department, and department of road police and maintenance.

A Train Order Holder for Engine Cabs.

An order holder for the use of engineers and conductors has been patented by L. C. Gibbs, of Marceline, Mo., and the accompanying illustration shows its application in the cab of a locomotive on the Santa Fe. Train orders when received are usually crumpled up,



Train Order Holder Mounted in Cab.

and crowded into the pocket along with other orders, and when necessary to refer to them, sometimes half a dozen orders will be taken out and unfolded before the right one is found. The device consists of four steel frames which rest in grooves in the bottom plate. A folding glass slide slips in at the top of the frame and between the glass leaves is a sheet of cardboard. The slide is lifted from the frame, the order is inserted, and the slide is slipped back. The order is held securely, and in plain view of the trainmen. The grooves keep the frames from swinging, but by lifting them a quarter of an inch they can be swung around in any direction, or folded up entirely. The order holder may be attached to any engine without changing the cab.

Language of the International Railway Congress.

Following the entrance of the German Government into the International Railway Congress, a statement has been made to settle misapprehension on that point, that the official language ofthe Congress will remain French, as heretofore. But German will hereafter be placed in the same status as English, and it is expected that the proceedings of the last session and future bulletins as well will in future be printed in this additional language.

"Record Discipline" on the L. & N.

Discipline without suspension has now been in force on the Louisville & Nashville since 1895. The officers of the company express marked satisfaction with the Brown plan, and this notwithstanding the fact that on the southern lines of the company there are a large number of colored employees. Each year a statement is made up showing the number of reprimands and demerits, etc., and the amount of wages saved to the employees by not suspending

them. For the last fiscal year this statement shows: Number of employees subject to the system, 7,243; number of suspensions (book suspensions, not actual suspensions), 3,162; wages saved to employees, $126,127; number of reprimands, 244; discharges on account of accumulated bad record, 5; discharges for other causes, 709; suspensions cancelled, 773; credit marks given, 19.

The Wellman-Seaver-Morgan Air Compressor.

The accompanying illustration, Fig. 1, shows the cylinder and valve arrangement for air compressors, adopted by the Wellman-Seaver-Morgan Company, Cleveland. This design is especially adapted to high-speed work and embodies a principle developed several years ago in South Africa by Mr. F. E. Norton, of the above mentioned company. The particular compressor shown herewith has a capacity of 4,000 cu. ft. of free air per minute compressed to 75 lbs. gage pressure. There are two air cylinders, the intake cylinder being 40 in. x 60 in., and the high-pressure cylinder being 25½ in. x 60 in. The air cylinders are water jacketed.

The general purpose of this design is to completely separate the positive closing of the discharge from its automatic opening. This is accomplished by dividing the discharge valve into two parts, one of which is positive and a part of the mechanical inlet valve (S). The discharge valve (D) is automatic, being controlled by a differential piston (P) operated by air pressure. The inlet (S) also positively controls the opening to the discharge valve (D), the opening being timed to take place near the beginning of the compression stroke.

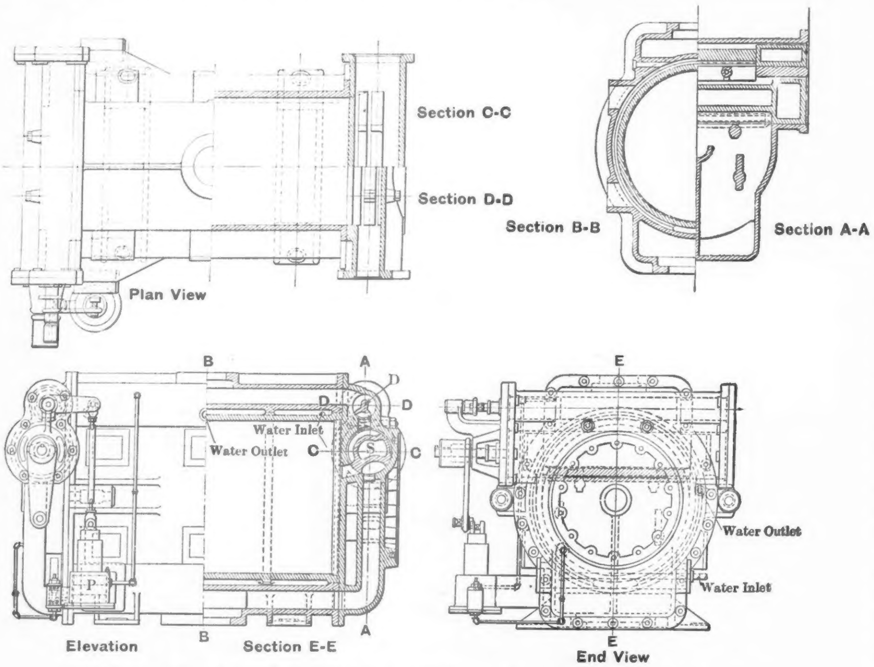


Fig. 1—Details of Air Cylinder—Wellman-Seaver-Morgan Compressor.

The theoretical card, Fig. 2, shows the events of the stroke. At (a) the valve (S) begins to open the inlet passage to the cylinder, air being drawn into the cylinder up to the end of the stroke at (b), at which latter point the inlet is closed by the return of the valve. As the piston moves toward the right, the valve (S) continues to rotate towards the left. At the point marked (c) on the diagram, the cylinder is brought in connection with the passage leading to the discharge valve (D). The discharge valve does not open until a point (d) is reached, the opening pressure being made a little less than the discharge pressure by the proportions of the differential piston (P), which controls valve (D). This arrangement overcomes any tendency of the air pressure in the cylinder to exceed the discharge pressure. The outlet valve (D) remains open during the entire discharge period and only commences to close on the return stroke of the main piston. In other words, the valve (D) closes during the period represented by the line (e a b) on the diagram. The time required for the opening and closing of the discharge valve is thus extended from about one-quarter of a stroke, with the usual poppet valve, to about 1¼ strokes with the improved valve. This feature permits high speed. There are no springs, hooks or complicated devices, and all parts, with the exception of the valves, are outside the cylinder. In case of water accumulating in the cylinders or operating pot, the valve (D) lifts from its seat so as to relieve the excessive pressure.

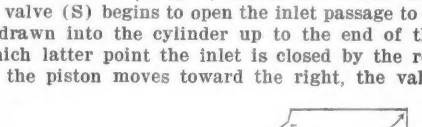


Fig. 2—Air Cylinder Card—Wellman-Seaver-Morgan Compressor.

The inlet area of the compressor is proportioned so that the loss of pressure in the cylinder at the end of the inlet stroke is less than two ounces per square inch. This design also reduces the clearance to less than 1 per cent., and the weight of air discharged per stroke is over 92 per cent. of the weight corresponding to the piston displacement. The inlet valve (S) is driven by a heavy eccentric.

A New Automatic Signal.

One of the common occurrences in the office of a technical journal is the visit of the inventor who calls on the editor to show some device that he has re-invented, some device that the caller has laboriously and innocently worked out when he could have found the whole thing in the files of the patent office records of 10, 20 or 40 years past. The latest re-inventor, an Ohio genius, did not call on the *Railroad Gazette;* but he has achieved publicity without the trouble of a journey to New York. Like inventors in other lines, he got his principle all right but made a mistake in a detail—the thickness of his rope. The story, as told in the *New York Tribune*, the soberest paper in New York, is as follows:

Cincinnati, July 14.—The inventive genius of a night operator on the Cincinnati, Hamilton & Dayton this morning aroused and frightened the residents of Hartwell, almost wrecked his station, offended an engineer and resulted in a 10-day vacation for the operator. For three hours after midnight there are no trains and the operators along the line try to get in a little sleep. The great anxiety is to wake up in time to give the morning flyer the "block." Failure to do this would mean suspension. The Hartwell operator strung a rope between two telegraph poles, many yards below the station, extending them over spools to his desk. On these he hung a coal bucket loaded with rocks. He figured that the train would cut the rope and the rocks fall with a din.

This morning the rope used was too heavy to be cut. The bucket of rocks was jerked out of the operator's window, taking sash and all. It then swung into a residence, crashing the glass in a door, and took up its clattering way down the ties. Half the town was awakened in a fright. The engineer pulled up after eight miles of the din, and finding a can tied to his pet, "210," made a loud and long complaint. . . .

The 28-Hour Cattle-Carrying Law.

"Don't tell me," said a Missouri Pacific brakeman, "about those fast Pennsylvania passenger runs. We were making a stock run into Omaha and we had to stop and back up to let the cattle catch their breath."—*Kansas City Star.*

That fabulous speed is a result, no doubt, of the excited efforts now being made to stave off conviction under those 1,200 suits which the Government has brought to punish the railroads for keeping cattle in the cars beyond the lawful number of hours.

Law-Breaking.

When our railroads are accused of violating the Interstate Commerce or anti-trust laws they profess the strongest desire to obey all reasonable regulations. Either they have obeyed the law so far as they knew how, and violations have been accidental, or the law has been one impossible to obey and do business, so they have been forced to reluctant lawbreaking for sheer self-preservation. Yet the chances are that these same persons will be found violating other laws with equal readiness, but without any such excuse. Just now the Department of Agriculture has entered upon a campaign to make the great railroads treat cattle humanely. The law is specific, perfectly easy to live up to and has been on the statute book since 1873. There can be no reason for disobeying it, at least habitually, except the saving of a little time, trouble and expense. The railroads might be expected uniformly to arrange their schedules for cattle trains so as to comply with the law and equip feeding yards within 28 hours of one another. So far have they been from doing this, however, that the Department of Agriculture has prepared papers in twelve hundred suits against the cattle carrying roads of the West for failure to observe the 28 hour law.

Now, the railroad managers responsible for this long career of law-breaking and cruelty doubtless consider themselves good citizens,

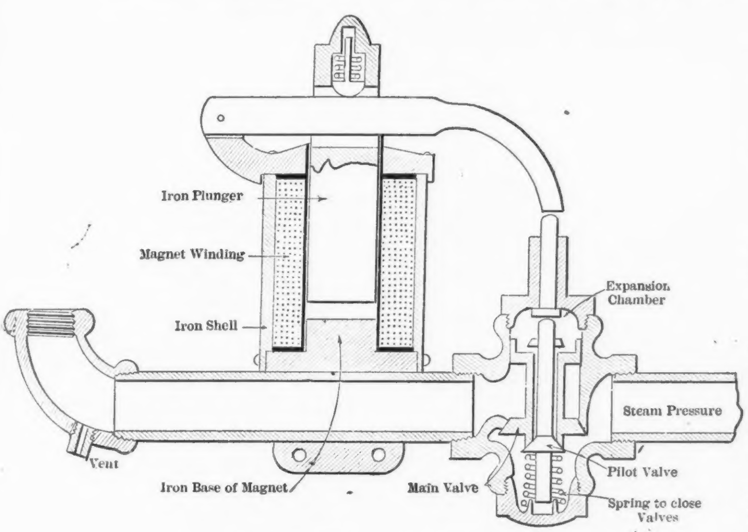
Probably some of them are members of societies for the prevention of cruelty to animals. But so little has their sense of personal responsibility for corporate acts guided them that they have, through their agents, inflicted suffering which they would recoil from inflicting with their own hands. . . . —*New York Tribune.*

Traffic Held Up by the Jaguar.

A press clipping from Colorado Springs, Colo., dated July 17, says that four passenger trains on the Colorado Midland Railroad were held at Tunnel No. 6, two miles west of Manitou, by a South American jaguar, which took possession of the line. The jaguar was traveling on a circus train. The roof of the tunnel knocked the top off his cage and he disembarked, and held the pass for some time.

Electrically Operated Whistle.

An electrically-operated whistle is shown in the accompanying cross-sectional engraving. It is intended chiefly for large shops or other plants where it is desirable to have a signal or an alarm whistle operative from remote points. The device is simple, its action being apparent from the drawing. The plunger of the solenoid actuates the lever, which opens the small pilot valve, admitting pressure to the expansion chamber above. This equalizes the pressure on the under side of the main valve, and further motion of the lever opens the main valve, permitting the fluid to pass. Spring pressure reseats the pilot valve and raises the solenoid plunger when the current is cut off. The solenoid may be wound for any voltage of either direct or alternating current, a "rectifier" being needed in the latter case. The valve may be used also on water, air or steam lines for other purposes than whistles, and is made for any pressure up to 200 lbs. It is made in two sizes, the smaller



Electrically Operated Whistle Valve.

operating whistles up to 3 in. diameter and the larger up to 6 in. diameter.

The Pennsylvania Railroad is using these whistles for fire alarm purposes. The Detroit Iron & Steel Company uses one to enable the power station engineman to signal the plant electrician whenever the switchboard indicates trouble. The Lodge & Shipley Machine Tool Co., Cincinnati, uses one for a signal and also in connection with the private telephone exchange in the plant. The whistle is made and sold by the Churcher Electric & Mfg. Co., Cincinnati, Ohio.

Relation Between Freight Rates and Tariffs.

One of the leaders of the German Liberal party, in the national legislature, spoke at the International Economic Conference recently held at Berlin on the subject of freight rates and their influence on tariff and trade policy. He held that freight rates should not conflict with nor impede the commercial policy of the home country. For instance, high rates on imported goods and low rates on exported products favor the formation of trusts, as is shown by the workings of the German coal trust. By such an arrangement raw materials or partly finished products are sold to foreign competitors at a much lower rate than to home consumers, to the serious injury of domestic manufacturers. The speaker also held that commercial treaties should guarantee the "most favored" treatment in regard to freight rates on goods of either of the contracting countries, so that the shipper in one country should have to pay no higher freight rates on his consignments carried in a foreign country than the native shipper of the foreign country pays, and that international through freight rates should be fixed from stations in one country to points in the other. The United States Consul General at Frankfort, Germany, declares that the proposition of most favored freight rates is an extremely important one and should be embodied in every future commercial treaty made by the United States with foreign powers. If this is done United States exports will not be discriminated against by differential freight charges when carried on the railroads, rivers, or canals of foreign countries.

Accidents in the First Quarter of 1905.

The Interstate Commerce Commission has issued accident bulletin No. 15, giving an account of railroad accidents in the United States during the months of January, February and March, 1905. This shows that during that quarter there were 28 passengers and 204 employees killed and 1,651 passengers and 2,062 employees injured in train accidents, making in all 232 persons killed and 3,713 injured. Other accidents to passengers and employees, not the result of collisions or derailments, bring the total number of casualties up to 15,306 (909 killed and 14,397 injured). There is a decrease of 42 in the total number of persons killed as compared with the quarter ending Dec. 31, 1904. The total number of collisions and derailments was 3,108 (1,787 collisions and 1,321 derailments), of which 284 collisions and 177 derailments affected passenger trains. The damage to cars, engines, and roadway by these accidents amounted to $2,449,248. There is an increase of 27 in the number of collisions and of 131 in the number of derailments as compared with the last preceding quarter. The total number of employees reported killed in coupling and uncoupling cars during this quarter was 62, being a decrease of nine as compared with those reported killed in the last preceding bulletin. The table showing the details of accidents to employees in coupling and uncoupling cars has been changed and amplified so as to show more clearly the circumstances under which the injuries occurred.

Freight and Express on Chicago Elevated.

The Chicago City Council has granted the Metropolitan West Side Elevated the right for ten years to carry freight and express.

New Turbine Steamer.

The Fore River Ship Building Company is to build a 6,000-ton turbine freight and passenger steamship for the New York and New Orleans service of the Morgan line (Southern Pacific).

Potatoes in Aroostook County.

The Bangor & Aroostook Railroad has completed its shipment of potatoes from the 1904 crop in Aroostook County, with a total of 6,693,612 bushels as against a total of 5,341,735 bushels last year from the 1903 crop, which was the largest on record.

Manufacturing and Business.

Charles H. Burgess, son of the late L. C. Burgess, of the Chicago Railway Equipment Co., has been appointed Sales Agent of the Holland Co., 77 Jackson boulevard, Chicago.

The Los Angeles (Cal.) office of the Westinghouse Electric & Mfg. Company, which has heretofore been in the Trust Building, has been removed to No. 527 South Main street.

The San Pedro, Los Angeles & Salt Lake Railroad, the new line from Salt Lake City to Los Angeles, has just opened an office in the Railway Exchange at 290 Broadway, New York City. This will be in charge of M. de Brabant, General Agent, and will be the eastern headquarters for freight and passenger business.

The N. L. Hayden Mfg. Co., Columbus, Ohio, has been given an order by the Baltimore & Ohio for 488 Hayden 4-in. all-brass pop safety valves for the 244 locomotives being built for that road by the American Locomotive Co. This is said to be the largest order of this sort ever given in this or any other country.

Mr. J. J. Casey has resigned as Superintendent of the works of the Haskell & Barker Car Company, Michigan City, Ind., which position he had held for over nine years. Mr. Casey was in the railroad and car building business for over 40 years, during which time he is said to have been out of employment only two weeks.

A. H. Whiteside, manager of the Allis-Chalmers Company's district office at Atlanta, Ga., has been transferred to the Philadelphia district office, where he succeeds as manager, W. A. Wood, resigned. M. W. Thomas has been appointed manager of the Chalmers Company's district office at Atlanta, Ga., and W. J. Buckley has been appointed manager of the company's district office at St. Louis. H. P. Hill, whom he succeeds, goes to the Salt Lake City district office, where he will devote himself to his specialty, the electrical features of the company's business.

During the six months ending June 30, 1905, the Westinghouse Machine Company, exclusive builders of the Westinghouse-Parsons type, have contracted for no less than 82,000 kilowatts in turbo-generating machinery, averaging nearly 1,175 k.w. capacity per turbine unit. These machines range in size from 200 k.w. to 7,500 k.w. The latter will be the largest turbines in the world, and three units of this size are under contract for Greater New York railway and lighting power stations. In the distribution of these machines among the various industries, the electric railway has claimed the largest number of machines, averaging 1,496 k.w. in capacity;

next in order, industrial plants, averaging 571 k.w. capacity, and light and power plants, averaging 1,529 k.w. capacity. In the order of total capacity, railway plants have required 38,900 k.w., lighting plants 26,300, industrial 12,000, miscellaneous 4,800.

In connection with the twenty-fourth annual convention of the American Street Railway Association, to be held at Philadelphia, Sept. 25 to 30, the American Street Railway Manufacturers' Association, through George Keegan, its Secretary, announces that the south pavilion of the Philadelphia Museums, together with another large building, have been secured as exhibition halls. These buildings together will furnish about 75,000 sq. ft. of floor space. There are also to be two railroad tracks of a total length of 1,000 ft. for outdoor exhibits. Space for exhibition purposes is restricted to members, who on payment of the annual membership fee of $35 will have the privilege of floor space at the exhibition.

The work of reinforcement of the Poughkeepsie bridge made necessary by the contemplated increase in the weight and amount of traffic by the New York, New Haven & Hartford Railroad, is soon to be started. The American Bridge Company, of New York, has been awarded the contract for the complete work on the metallic structure. Operations at the bridge site will be started in a short time and it is expected that the strengthening will be completed within 16 to 18 months. The entire work, which will involve an expenditure in the vicinity of $1,500,000, will be under the immediate supervision of Mace Moulton, Consulting Engineer, 150 Nassau street, New York, retained by the railroad company to investigate the strength and prepare plans for the reinforcement.

Iron and Steel.

The Colorado & Southern is negotiating with the Colorado Fuel & Iron Company for 6,000 tons of 80-lb. rails.

The Cleveland, Cincinnati, Chicago & St. Louis and the Lake Shore & Michigan Southern recently placed orders for rails aggregating about 23,000 tons, of which 15,000 tons will be furnished by the Carnegie Company, and 8,800 tons by the Lackawanna Steel Company.

The Kansas City Southern, it is reported, has placed an order for 12,000 tons of rails with the Republic Steel & Iron Company, which recently started its mills at Youngstown, Ohio. The daily output is 1,000 tons. The latter company is reported to have booked orders for about 25,000 tons.

Announcement is made by the Pittsburg Steel Foundry that it has organized a company to make steel castings, to be called the Pittsburg Equipment Company. Stewart Johnston, President of the Pittsburg Steel Foundry, will be the President of the company, and O. S. Pulliam, General Manager.

PERSONAL.

—Mr. Rolla Jabish Parker, who was recently promoted from Superintendent of the Missouri Division to be General Superintendent of the Western Grand Division of the Atchison, Topeka & Santa Fe, was born Jan. 27, 1857, at Roscoe, Minnesota, and was educated at the Shattuck School at Faribault, Minnesota. His first railroad work was in 1872 as brakeman on the Chicago, Milwaukee & St. Paul. After two years as brakeman he went back to school for a year and in July, 1875, returned to his railroad position. In 1877 he was made conductor. He left the Chicago, Milwaukee & St. Paul, in 1881, to go to the Northern Pacific as conductor of construction train, and in 1884, he was conductor and foreman in charge of construction on the Fargo & Southern, now part of the Chicago, Milwaukee & St. Paul. His first service with the Santa Fe was in 1887, when he went to that road in a position similar to that held by him on the Northern Pacific. He was promoted in 1887 to be Division Roadmaster, and in 1893 to be General Roadmaster of the Eastern division. When the office of General Roadmaster was abolished his title was changed to Division Roadmaster. This he held until January, 1897, when he was appointed Superintendent of the Middle Division, with headquarters at Newton, Kansas. Three years later he was transferred as Superintendent to the Western division, and in January, 1901, was appointed Superintendent of the Colorado division of the Santa Fe, including a joint line with the Colorado & Southern, with headquarters at Pueblo, Colorado. In April, 1903, he was again transferred, this time to the Missouri division, with headquarters at Marceline, Missouri, from which post he was promoted directly to be General Superintendent of the Western Grand Division.

—Mr. H. Cleveland Beattie, President of the Blue Ridge Railway, died at his home in Greenville, S. C., on July 15, after an illness of several weeks.

—Mr. William W. Buffum, for 14 years Superintendent of the Lake Shore & Michigan Southern, died, recently at his home in Buffalo at the age of 63.

ELECTIONS AND APPOINTMENTS.

Arkansas Midland.—J. D. Moore has been appointed Superintendent of this road and of the Brinkley, Helena & Indian Bay, with headquarters at Helena, Ark., succeeding J. B. Johnson, resigned.

Baltimore & Ohio.—P. H. Irwin, Assistant Chief Engineer, has been appointed Consulting Engineer, with headquarters at Baltimore, succeeding David Lee, deceased. John E. Greiner, Engineer of Bridges and Buildings, has been appointed Assistant Chief Engineer, with headquarters at Baltimore, succeeding Mr. Irwin.

Brinkley, Helena & Indian Bay.—See Arkansas Midland.

California Western Railway & Navigation.—Frank Trumbull, President of the Colorado & Southern, has been elected President of this road also.

Canadian Northern.—J. R. Cameron, Assistant Superintendent of the Kamsack division, has been appointed Superintendent of the new division west of Humbolt, Saskatchewan.

Canadian Pacific.—H. H. Abbott has been appointed General Freight Agent, with headquarters at Calgary, Alberta.

Central of Georgia.—G. H. Richter, Chief Clerk of the law department, has been elected Assistant Secretary.

Chicago & Alton.—C. G. Delo, Division Engineer of the Chicago Great Western at Des Moines, has been appointed Engineer of Maintenance of Way of the Western division, with headquarters at Kansas City, Mo.

Chicago, Burlington & Quincy.—D. O. Ives, General Freight Agent of the Lines West of the Missouri River, has resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—Charles B. Clark, Assistant Engineer, has been appointed Chief Engineer of Maintenance of Way of this road and of the Peoria & Eastern.

Arthur S. More, Assistant Engineer of the Chicago division, has been appointed Engineer of Maintenance of Way of the Michigan division, with headquarters at Wabash, Ind.

A. L. Kuehn, Engineer of Maintenance of Way at Wabash, Ind., has been appointed Chief Assistant Engineer, in charge of Maintenance of Way, with headquarters at Indianapolis.

Coal & Coke.—See South & Western.

Colorado Springs & Cripple Creek District.—J. H. Waters, President of the Florence & Cripple Creek and of the Midland Terminal, has been elected General Manager of this road.

See Wabash.

Conway Coast & Western.—James H. Chadbourn has been elected President, and E. P. Schulken, Secretary and Treasurer.

Cripple Creek Central.—D. C. MacWatters, General Passenger Agent of the Colorado & Southern, and of the Colorado Springs & Cripple Creek District Railway, has been appointed General Passenger Agent of the Cripple Creek Central, succeeding J. B. Wiggenhorn, resigned. F. C. Smith, Superintendent of the Colorado Springs & Cripple Creek District, has also been appointed Superintendent of the Cripple Creek Central. W. A. Matlock, General Freight Agent of the Cripple Creek Central, has been appointed Traffic Manager of the Cripple Creek Central and of the Colorado Springs & Cripple Creek District Railway.

See Colorado Springs & Cripple Creek District.

Delaware, Lackawanna & Western.—R. P. Schilling, Master Mechanic at Utica, has resigned, these shops having been abandoned.

Denver & Rio Grande.—W. B. Hall has been appointed General Storekeeper, with office at Denver, Colo.

The jurisdiction of W. E. Miller, Assistant Superintendent of the First and Second divisions, has been extended over the Third and Fourth divisions.

El Paso-Northeastern System.—F. L. Carson, Master Mechanic of

the Gulf, Colorado & Santa Fe, at Cleburne, Tex., has been appointed Master Mechanic at Alamogordo, N. Mex.

Grand Trunk Pacific.—Dennis O'Brien, Master Mechanic of the Grand Trunk at Point St. Charles, has been appointed Assistant to the Vice-President and General Manager, with headquarters at Winnipeg.

Great Northern.—W. Willerton, Assistant Division Superintendent at Spokane, has been assigned to special work in the general office at St. Paul. George E. Johnson, Chief Clerk to the Assistant General Superintendent, has been temporarily appointed Assistant Division Superintendent at Spokane, Wash., succeeding Mr. Willerton.

Gulf & Inter-State.—Louis Featherstone, Superintendent, has been appointed Traffic Manager. Dee Featherstone has been appointed Superintendent.

Gulf, Colorado & Santa Fe.—C. A. Snyder, General Foreman at Galveston, Tex., has been appointed Master Mechanic, with headquarters at Cleburne, Tex., succeeding F. L. Carson, resigned. Raymond Bell has been appointed General Foreman, succeeding Mr. Snyder. See El Paso-Northeastern System.

Illinois Central.—J. F. Merry, Assistant General Passenger Agent, has been appointed General Immigration Agent of this road and of the Yazoo & Mississippi Valley, with headquarters at Manchester, Iowa.

Isthmian Canal Commission.—Arthur M. Burtt, Assistant Engineer and Chief Draftsman, has been appointed Supervising Architect, with headquarters at Ancon, Canal Zone.

Lake Erie & Western.—G. P. Smith, Engineer of Maintenance of Way of the Indiana, Illinois & Iowa, at Kankakee, Ill., has been appointed Assistant Chief Engineer, succeeding G. C. Cleveland. See Lake Shore & Michigan Southern.

Lake Shore & Michigan Southern.—E. A. Handy, Chief Engineer, has been appointed Assistant General Manager, with headquarters at Cleveland, Ohio. Samuel Rockwell, Assistant Chief Engineer, has been appointed Chief Engineer, succeeding Mr. Handy. G. C. Cleveland, Assistant Chief Engineer of the Lake Erie & Western, has been appointed Assistant Chief Engineer, succeeding Mr. Rockwell.

Missouri, Kansas & Texas.—John Madden has been appointed General Attorney, succeeding T. N. Sedgwick, deceased.

Missouri Pacific.—E. Fisher, Engineer of Bridges and Buildings of this road and of the St. Louis, Iron Mountain & Southern, has resigned.

National Transcontinental Railway Commission.—Collingwood Schreiber, Deputy Minister of Railways and Canals of Canada, has been appointed Consulting Engineer. M. J. Butler, Assistant Engineer, has been appointed Deputy Minister of Railways, succeeding Mr. Schreiber.

New Orleans Terminal.—C. H. Fisk has been appointed Terminal Engineer, succeeding F. G. Jonah. See St. Louis & San Francisco.

Oregon Railroad & Navigation.—J. P. O'Brien, General Manager, has also been elected Vice-President.
See Union Pacific.

Pennsylvania.—J. P. Heindell, Assistant Trainmaster at Olean, has been appointed Superintendent of Docks and Terminals at Buffalo.

St. Louis & San Francisco.—F. G. Jonah, Terminal Engineer of the New Orleans Terminal Company, has been appointed Assistant Engineer in charge of the deep water terminals at Chalmette, with headquarters at New Orleans, succeeding E. M. Lisle, resigned.

St. Louis Southwestern.—C. H. Séabrook, General Foreman of the Pine Bluff shops, has been appointed Master Mechanic, with headquarters at Pine Bluff, Ark.

South & Western.—George F. Syme, Resident Engineer of the Coal & Coke at Delta, W. Va., has been appointed Resident Engineer at Spruce Pine, N. C.

Union Pacific.—Winslow S. Pierce has resigned as director of this road and also of the Southern Pacific, the Oregon Short Line and the Oregon Railroad & Navigation Company.

Tidewater.—The general offices of this new road will be located in Norfolk, Va.

Yazoo & Mississippi Valley.—See Illinois Central.

Wabash.—D. O. Ives, General Freight Agent of the Lines West of the Missouri River of the Chicago, Burlington & Quincy, has been appointed Freight Traffic Manager, succeeding Milton Knight, deceased.

LOCOMOTIVE BUILDING.

The Indiana Harbor is reported to have ordered $2,500,000 worth of equipment.

The Pennsylvania Lines West, it is reported, will order 20 new locomotives, 10 consolidation type (2-8-0) and 10 six-wheel (0-6-0) switching locomotives.

The Illinois Central, as reported in our issue of July 14, has ordered five simple Pacific type (4-6-2) locomotives from the American Locomotive Co. These locomotives will weigh 221,000 lbs., with 140,500 lbs. on the drivers; cylinders, 22½ in. x 26 in.; diameter of drivers, 75 in.; radial stayed boiler, with a working steam pressure of 210 lbs.; heating surface, 3,379 sq. ft.; 304 tubes, 2 in. in diameter and 20 ft. long; wide firebox, 102⅞ in. x 72⅜ in.; grate area, 51 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 15 tons.

CAR BUILDING.

The Grand Trunk has ordered 1,000 box cars from the Canada Car Co.

The Indiana Harbor is reported to have ordered $2,500,000 worth of equipment.

The Delaware & Hudson expects to build a sample coal car, preliminary to building several hundred.

The Philadelphia & Reading is reported to have ordered 1,000 steel hopper cars of 100,000 lbs. capacity from the Standard Steel Car Co.

The New York, Ontario & Western has ordered two combination passenger and baggage cars from the American Car & Foundry Co., for September delivery.

The Panama Canal Commission has given the Middletown (Pa.) Car Works a trial order for 40-ton King-Lawson self-dumping cars. If the cars are satisfactory, 500 more will be ordered.

The Tidewater Railroad is reported to have ordered 250 self-clearing hopper cars of 80,000 lbs. capacity, with wooden frames and underframes, and 250 steel underframe cars of 100,000 lbs. capacity. Part of these are for the Deepwater Railroad.

The St. Louis & O'Fallon has ordered 300 steel gondola cars of 100,000 lbs. capacity from the American Car & Foundry Co. These cars will weigh about 40,000 lbs., and measure 41 ft. 9 in. long, 9 ft. 4⅞ in. wide and 4 ft. high, all inside measurements. The special equipment includes: Westinghouse airbrakes and Miner draft rigging.

The Missouri, Kansas & Texas, as reported in our issue of June 30, has ordered 1,750 box cars and 250 ventilated box cars, both of 60,000 lbs. capacity; 50 flat cars of 80,000 lbs. capacity; 155 Rodger convertible ballast cars of 80,000 lbs. capacity, and 50 cabooses from the American Car & Foundry Co., for September, October and November delivery. All box cars will measure 36 ft. long, 8 ft. 6 in. wide, and 8 ft. high, with wooden frames and underframes. The flat cars will measure 40 ft. long, 9 ft. 3 in. wide, and 4 ft. 1¾ in. high, and will have wooden frames and underframing. The ballast cars will measure 22 ft. long, 8 ft. 8 in. wide and 4 ft. high. The cabooses will measure 29 ft. 3⅝ in. long, 8 ft. 3⅝ in. wide, and 7 ft. 4 in. high, with wooden frames and underframes. Dimensions are all inside measurements. The special equipment for all cars will include: Diamond "S" brake shoes, steel axles, American dust guards, Miner tandem draft rigging, M., K. & T. standard paint, and American Car & Foundry Co.'s wheels. The ballast cars will have Damascus brake-beams, Logan couplers, and Common Sense trucks. The box cars, flat cars and cabooses will have National Hollow brake beams, Major 5 in. x 7 in. shank couplers, and American cast-steel trucks, excepting the cabooses, which will have M., K. & T. standard caboose trucks.

BRIDGE BUILDING.

ATLANTIC, MASS.—The New York, New Haven & Hartford is planning to build a four-track steel bridge to replace the present wooden structure over the Neponset river on its Plymouth division between this place and Neponset.

AVONDALE, LA.—According to reports, plans are being made for building a large bridge over the Mississippi river at this place, near New Orleans. This is reported to be a project of the Southern Pacific.

BEDFORD, N. S.—The Intercolonial has given contracts to F. A. Ronan & Co., of Halifax, for building the substructure, and to the Dominion Bridge Co., of Montreal, for the steel superstructure of a bridge 285 ft. long to carry double track to be built over the Sackville river.

CLEVELAND, OHIO.—Petition has been made to the county to bear

a share of the cost of building a new viaduct connecting Fleet street, Harvard street and Washington Park. The city will contribute about $40,000, property owners $7,000, and the county will be asked to pay an additional $25,000.

Dayton, Ohio.—Bids are wanted July 27, by T. J. Kauffman, County Auditor, for the substructure and the steel superstructure, consisting of two spans each 150 ft. long, with 16 ft. roadway, also approaches of a bridge to be built over Big Twin creek between Montgomery and Preble counties.

Denver, Colo.—Bids are wanted July 29 by T. W. Jaycox, State Engineer, for building a steel bridge 125 ft. long over Purgatory River at Sopris, in Las Animas County.

Elmira, N. Y.—The Lake Street Bridge Commission which recently opened bids for the new Lake street bridge has decided to give the contract to the American Bridge Co. at $46,877, the work to be completed by November 1st of this year, and is asking bids for the sale of the metal work of the present structure.

Fort Wayne, Ind.—The County Commissioners have appropriated $17,000 for building a bridge over the Maumee river in Allen County.

Hoult, W. Va.—The Baltimore & Ohio, it is said, is planning to build a bridge over the Monongahela river at this place.

Iowa Falls, Iowa.—The Des Moines, Iowa Falls & Northern, it is reported, will build a bridge over the Iowa river, to cost $40,000.

La Porte, Ind.—Bids are wanted July 24, by the Board of Commissioners for putting up a number of bridges in La Porte County. Charles H. Miller is Auditor.

Lorain, Ohio.—The Lake Shore Electric is surveying to locate the site for a new steel bridge over the Black river at South Lorain.

Lowell, Mich.—The Council has decided to accept the proposition of the Grand Rapids & Ionia Interurban to build three bridges over Flat river.

Minneapolis, Minn.—Plans are being made for building a bridge over the tracks at University avenue.

Montreal, Que.—Bids are being asked by David Seath, Secretary of the Harbor Commissioners of Montreal, for building a steel foot bridge on Victoria pier, to cost about $12,000.

Morris, Man.—The Canadian Northern Railroad bridge to be built over the river at this place will be 800 ft. long and cost about $250,000.

New Brunswick, N. J.—Bids are wanted July 26, by the Board of Chosen Freeholders for putting in three steel spans each 150 ft. long at the Amboy bridge over Raritan river in Middlesex county. A. Fountain is Director.

New York, N. Y.—Plans for an underground terminal at the Delancey street end of the Williamsburg bridge have been approved by the Board of Estimate, and the Bridge Department instructed to go ahead with the work. The plans call for a subway terminal into which the elevated and surface cars will run from the bridge, the extension of the present plaza 200 ft. along the block bounded by Suffolk, Norfolk, Broome and Delancey streets to make Delancey street from Clinton to Norfolk of uniform width. The plaza so formed to Norfolk street is to be closed as a street and declared a bridge approach.

Pittsburg, Pa.—The Select Council, at a recent meeting, passed an ordinance providing for the building of a bridge at Washington avenue and Sedgewick street crossing of the Pittsburg, Fort Wayne & Chicago.

The Pittsburg union bridge is to be reconstructed and raised to a height of 70 ft. over the Allegheny river. The bridge is now only 40 ft. over the water line. The change has been ordered by the Secretary of War.

Portland, Me.—The bids recently opened for building the bridge to replace the Vaughans bridge, were for three kinds of structures. The lowest bid for a structural steel bridge was that of the Mount Vernon Bridge Company, of Columbus, Ohio, $333,000; the lowest for a pile structure with a steel draw, was made by P. E. Lane, of Atlantic City, N. J., $135,000; other bids were, American Bridge Company, $370,000, $372,500, and $376,700; New England Structural Steel Company, of Boston, steel bridge, $450,000; Boston Bridge Works, steel bridge, $480,000; Augustus Smith, of New York, various bids ranging from $229,032, to $366,765; Holbrook, Cabot & Roberts, pile bridge with steel draw, $253,000; New Jersey Bridge Company, steel bridge, $339,555.

Poughkeepsie, N. Y.—The New York, New Haven & Hartford has given the contract for building the Poughkeepsie bridge to the American Bridge Co., mentioned in another column. The order covers 15,000 tons of fabricated steel.

St. Boniface, Man.—The City Council has decided to contribute $50,000 toward building a bridge over the Red river.

St. Johns, N. B.—The Canadian Pacific has secured a controlling interest in the St. John Bridge & Railway Extension Co. and will shortly begin the rebuilding of the cantilever bridge.

Stockton, Mo.—Bids are wanted August 11 by J. H. Butler, County Clerk, for building a steel bridge about 180 ft. long in Cedar County.

Other Structures.

Austin, Tex.—The Houston & Texas Central is building with its own forces a 10-stall brick roundhouse.

Birmingham, Ala.—The Birmingham Terminal Co. has recently been organized to build a union passenger station. G. B. McCormack is President.

Brooklyn, N. Y.—The Brooklyn Rapid Transit Co. has commenced the work of rebuilding the present Union Station at Fifth avenue and 36th street, and will make other improvements, including the construction of a four-track station, a new shop building, inspection pits and sheds and a storage yard, at a cost of about $250,000.

Champaign, Ill.—The Cleveland, Cincinnati, Chicago & St. Louis is putting up with its own forces a brick station with slate roof, one story high, 32 ft. x 103 ft., to cost $10,000, at this place, on its Peoria & Eastern division.

Chikasha, Ind. T.—The Chicago, Rock Island & Pacific, it is said, will make improvements at a cost of $65,000, the principal part of which will be used to put up a new station which will also hold the division offices.

Iowa Falls, Iowa.—The Des Moines, Iowa Falls & Northern will, it is said, put up a new passenger station.

Knoxville, Tenn.—Work has been commenced by the Louisville & Nashville on large repair shops near this city, to cost about $100,000.

Las Vegas, Nev.—The San Pedro, Los Angeles & Salt Lake is planning to put up a passenger station.

Long Island City, N. Y.—The Long Island Railroad is planning to build five stations, at Lawrence, at Locust Valley and Sayville, on which work is to be started at once, and at Cedarhurst and Hewletts, at a total cost of about $90,000.

Mansfield, Ohio.—The Pennsylvania will build a roundhouse at this place.

Nashville, Tenn.—The roundhouse of the Louisville & Nashville was totally destroyed by fire July 6. Seven locomotives were also destroyed, and five others badly damaged, causing a loss of $150,000.

Newark, N. J.—The Central of New Jersey is making plans for putting up a combined freight station and warehouse, to cost over $500,000.

New York, N. Y.—The New York Central & Hudson River has filed plans for putting up three new brick stations in the Bronx at an aggregate cost of $125,000.

San Francisco, Cal.—The Atchison, Topeka & Santa Fe is said to be making plans to put up freight sheds at China Basin, which will be among the largest in the country. The plan is to have the piers and wharves so connected that freight may be transferred to overland trains.

Santa Maria, Cal.—The Pacific Coast Railway is planning to put up a large passenger station.

Sioux City, Iowa.—The Chicago, St. Paul, Minneapolis & Omaha has given a contract to G. S. Lounsburry, of Duluth, at about $50,000 to put up a 25 stall roundhouse near this place.

Springfield, Ohio.—Negotiations are under way between the Pittsburg, Cincinnati, Chicago & St. Louis and the Cleveland, Cincinnati, Chicago & St. Louis, to jointly build a passenger station here to cost $350,000.

Winnipeg, Man.—Plans for the new Canadian Pacific train shed to be built here, have been approved and work will be commenced at once.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Atchison, Topeka & Santa Fe.—Announcement has been made that this company will build an extension of its Lampasas branch from San Angelo, Tex., west to Rincon, N. Mex., about 390 miles, where connection will be made with its transcontinental line. The building of this cut-off will reduce the distance between San Francisco and Galveston by the Santa Fe several hundred miles.

Buchanan & Tazewell.—A charter has been granted this company in Virginia to build a railroad in that state. The headquarters

of the company will be at Whitewood, Buchanan County, Va. The incorporators include John F. Hager, G. F. Hager and M. F. Fleming, all of Ashland, Ky.

Buffalo & Susquehanna.—This company is building a freight extension from Sykesville, Jefferson County, Pa., southwest to the Plumville coal fields, a distance of about 25 miles. The northern extension of the company's line from Wellsville to Buffalo is expected to be finished and ready for the running of trains by the first of next year.

California-Western Railroad & Navigation Company.—This company has been incorporated in California with a capital of $1,000,000 to build a railroad in Mendocino County from Fort Bragg to Alpine and Willets, about 41 miles. The road is to connect with the Union Lumber Company's railway, and with its branches is to have a length of 65 miles. The directors include Duncan McNee, Miles W. McIntosh, Charles H. Weller, H. M. Cochran and Max Goldberg, all of San Francisco.

Canadian Yukon Western.—A bill has been passed by the Commons Railway Committee authorizing this company to issue stock and extending the time for building its proposed road from the Yukon to the Pacific coast.

Chicago, Rock Island & Pacific.—This company, it is said, is planning to build a cut-off from Fairbury, Neb., south to Herington, Kan. The proposed route is from Fairbury to Clifton, using the present main line south from Clifton to Broughton, and the further construction of the line from Broughton to some point near Enterprise on the Salina branch, and using this branch running directly south the remainder of the way to Herington. The work requires the building of about 60 miles of new road; this will give a new route between the northern main line of the Rock Island passing through Omaha, and the south line of the Rock Island running through Wichita.

Cleveland, Cincinnati, Chicago & St. Louis.—This company is planning improvements on its Cairo division, between Danville and Harrisburg. The work includes reduction of grades, elimination of curves, elevation of low places, widening of the embankment, laying of new and heavier rails, increase of terminal and yard facilities at various points, and all curvatures are to be reduced to two degrees and grades to 26.2 ft. per mile. The line from Harrisburg to Danville will be entirely rebuilt, the roadbed being widened to 20 ft. instead of 9 ft., as heretofore, and the entire surface ballasted with stone. The line will be materially changed at Norris City, cutting out a troublesome curve at that place. No towns of importance will be cut out, although in many of them the road will pass through a different portion. All wooden bridges will be replaced by steel structures. All culverts and water openings will be of stone.

Colorado, Texas & Mexico.—This company, which has its general office at Abilene, Tex., has completed the grade of twenty-five miles of road south from that place. It is proposed to build from Vernon, Tex., on the Fort Worth & Denver City road, to San Antonio, with a branch line to Washburn, Tex.

Eastern Washington.—Rights of way are being secured by this company for a railroad, projected to run from Fletcher in Adams County, Wash., southwest to Connell, a distance of about 30 miles.

Gainesville, Whitesboro & Sherman (Electric).—A charter has been filed in Texas by this company, with a capital of $500,000, and offices at Gainesville, to build a railroad 32 miles long. The incorporators include G. A. Hassinger, H. L. Lazarus, New Orleans; H. G. Stinnett, Sherman; S. R. Cowell, Whitesboro, and John King and others, Gainesville.

Gulf Terminal Company.—Incorporation has been granted a company under this name in Alabama to build and operate a union passenger station in the city of Mobile and to construct and operate a terminal railway through and around that city. The incorporators include: E. L. Russell, of the Mobile & Ohio; F E. Winson, of Washington, D. C., and others.

Kansas City & Excelsior Springs.—A charter has been granted a company under this name in Missouri with a capital of $850,000 to build a railroad from Kansas City northeast to Excelsior Springs in Clay County, Mo. W. J. Thurman, McKinney, Tex.; A. F. Martin, C. D. Pratt, J. Williams, and Eugene G. Jaccard, of Kansas City, are interested.

Kansas City, Mexico & Orient.—This company has put in operation from Sweetwater, Tex., north to Sylvester, 22 miles of its railroad. Grading is finished from Sylvester north to the Red river, where it will connect with the Oklahoma division, now being built, a distance of about 100 miles from Sylvester. Track-laying is in progress on this division and it is expected that it will be completed and in operation by fall. Construction work is also under way south from Sweetwater towards San Angelo and the Mexican border.

La Crosse & Southeastern.—This road has been completed from La Crosse, Wis., southeast to Viroqua, 42 miles, and is now in operation.

Madisonville, Hartford & Eastern.—Articles of incorporation have been filed by a company under this name in Kentucky, with headquarters at Hartford, to build a railroad from Madisonville northeast to Fordsville or Cloverport, a distance of about 80 miles. The incorporators are R. E. L. Simmerman, J. W. Ford, H. H. Holeman, Rowan Holbrook, G. R. Lynn, Dr. J. P. Ross, John T. Moore, of Hartford. (See Kentucky Roads, June 30, p. 215.)

Missouri Valley (Electric).—A charter has been granted this company in Missouri, with a capital of $650,000, to build an electric road from Kansas City north along the Missouri river to St. Joseph, about 65 miles, with spurs to Leavenworth and Atchison. The board of directors includes G. B. Blanchard, Charles P. Breen, George B. Tuggle, S. Facker, Wilson McAfee and Howard McAfee, all of Parkville, Mo. Nevins & Co., of New York, are said to be interested.

Morgantown & Kingwood.—This company, which operates about 15 miles of road in West Virginia, has completed its extension from Bretz southeast to Reedsville, and has now under construction about 12½ miles from that place to Kingwood. The company will at once ask for bids on an additional 18 miles south from the latter place to Rowlesburg.

New York City.—The Board of Estimate has approved the plans of the Rapid Transit Commission for building 19 new subways at an aggregate cost of $250,000,000.

New York, Westchester & Boston.—The amended route of this company's proposed road has been approved by the board of estimate and apportionment of New York City. The City & County Contracting Co., which has the general contract to build this road, will soon ask for bids on the work.

Oklahoma Northwestern.—Rights of way, it is said, have been secured by this company from Doxey, Okla. T., northwest for about 100 miles, and construction work is soon to be commenced.

Pittsburg, Binghamton & Eastern.—Permission has been granted this company by the New York Railroad Commission to build in New York State. The proposed route is from Binghamton, N. Y., southwest to Ansonia, Pa., a distance of about 140 miles. (May 26, p. 175.)

Public Service Corporation.—Petition has been made by this company for authority to build an electric road from Elizabeth, N. J., to Rahway, about eight miles.

St. Louis, Iron Mountain & Southern.—Announcement has been made that this company has authorized the laying of a second main track in Arkansas from Texarkana northeast to Fulton, a distance of 19 miles, and from Ensign, south of Little Rock, to McAlmont, north of that place, a distance of about 13 miles, to relieve the terminals at Little Rock and Texarkana.

St. Louis, Rocky Mountain & Pacific.—This company, which was recently organized, has just bought the Raton, N. Mex., coal fields, comprising about 520,000 acres, and including an area of more than 800 square miles. The new owners will, through a subsidiary company, immediately build 120 miles of steam railroad through the Cimarron canon, the only remaining pass across the Rocky Mountains that will admit of the construction and operation of a transcontinental road within the United States. This railroad, in addition to serving the coal mines of the St. Louis, Rocky Mountain & Pacific Company, will traverse a heavily timbered country and reach the well-known Elizabethtown mining district in the northern part of New Mexico, where there are a large number of gold mines and extensive iron deposits. It will also furnish an outlet to the Taoz valley. Work will begin on the new road early next month. (March 24, p. 90.)

St. Maurice Valley.—A bill has been passed authorizing this company to build a line from Three Rivers, Que., to the eastern division of the Grand Trunk Pacific.

San Pedro, Los Angeles & Salt Lake.—Surveys are reported being made to build a branch from a point on this road in Salt Lake City southeast about 100 miles to the coal fields of Carbon and Emery Counties, paralleling the main line of the Rio Grande Western.

Sparks, Moultrie & Gulf.—This road, which was operated for some time but has since been abandoned, is to be rebuilt and operated from Adel, in Berrien County, Ga., north to Sparks, and thence west to Moultrie, in Colquitt County, a distance of about 18 miles. At Adel connections will be made with the South Georgia and West Coast; at Sparks, with the Nashville & Sparks and the Georgia Southern & Florida roads, and at Moultrie, with the Atlantic & Birmingham and Georgia Northern.

Tidewater & Western.—Under this name a charter has been given to this company in Virginia. The company will take over the Farmville & Powhatan, which operates 92 miles

of road in Virginia, from Bermuda to Farmville, with a branch from Coalboro three miles long. It is proposed to extend this road either to Danville or Lynchburg. The directors of the new company include T. F. Jeffress, H. W. Anderson, L. C. Lewis, J. S. Ellett and James N. Boyd, of Richmond, Va.

Ultima Thule, Arkadelphia & Mississippi.—This road, which extends from Daleville in Clark County, Ark., where connection is made with the St. Louis, Iron Mountain & Southern, southeast to Sparkman, a distance of 26 miles, has been opened for traffic. C. G. Carpenter, Arkadelphia, is General Manager.

Virginia & Southwestern.—This road has put in operation the Taylor mines branch from Rexford, Tenn., east to Buladeen, 10 miles.

Wabash.—Surveys are reported being made by this company for a line from a point on the West Side Belt (Wabash), near Castle Shannon, southward through Allegheny County, Pa., and across the eastern end of Washington County, to Clarksville, Greene County, to reach valuable coal lands. The proposed extension will cross the Baltimore & Ohio near Fanteville.

Yellowstone Park.—This company, which is being financed by Philadelphia capitalists represented by F. A. Hall, and in which P. H. Gallagher, of Billings, Mont., is interested, has given a contract for excavation work to Weast Bros.; also a contract for grading 18 miles of its road from Bridger, in Carbon County, Mont., to the Bear Creek Coal Camp. Additional contracts will soon be let for removing rock and for building bridges and culverts. Russell Kimball is Construction Engineer.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—A semi-annual dividend of 2½ per cent. has been declared on the common stock. The first payment on the common stock was in 1900 and ever since that time 4 per cent. has been paid annually.

Central of Georgia.—The directors have authorized an issue of $600,000 4 per cent. bonds, secured by mortgage on 10 miles of road now under construction to reach valuable coal fields in northern Alabama.

Cleveland, Cincinnati, Chicago & St. Louis.—The stockholders have subscribed to only $2,869,700 of the $7,600,000 new common stock recently offered to both classes of stockholders at par to the extent of 20 per cent. of their holdings.

Cripple Creek Central.—This company, which is the successor at foreclosure sale of the Denver & Southwestern, has declared its first dividend of 3 per cent. on its $3,000,000 4 per cent. non-cumulative preferred stock.

It is probable that the Colorado & Southern now controls this road. J. H. Waters, President of the Florence & Cripple Creek and the Midland Terminal, has been appointed General Manager of the Colorado Springs & Cripple Creek District Railway, already controlled by the C. & S. The two companies, of which Mr. Waters is President, cover most of the main line mileage (83 miles) controlled by the Cripple Creek Central, which is in effect a holding company. Of this mileage, 63 miles is narrow gage. Several officials of the Colorado & Southern have also been appointed to similar positions on the Cripple Creek Central. The general offices of the Florence & Cripple Creek and the Midland Terminal are shortly to be removed from Cripple Creek to Denver.

Farmville & Powhatan.—See Tidewater & Western.

Galveston, Harrisburg & San Antonio.—The shareholders of the Gulf, Western Texas & Pacific, and the New York, Texas & Mexican will, on August 8, vote on selling these roads to the Galveston, Harrisburg & San Antonio. These are all Southern Pacific companies. The sale was authorized at the recent session of the Texas legislature.

Lehigh Valley.—The New York State Railroad Commission has recently authorized the Lehigh & Lake Erie, a subsidiary company of the Lehigh Valley, to issue $3,000,000 bonds for the construction of a terminal line at Buffalo.

Louisville & Nashville.—Application has been made to the New York Stock Exchange to list $2,840,000 additional unified 50-year 4 per cent. bonds of 1940, making the total amount listed $34,562,000.

Missouri Pacific.—The New York Stock Exchange has been asked to list $25,000,000 40-year 4 per cent. gold bonds of 1945. These are part of an authorized issue of $50,000,000 dated 1905. They are secured by St. Louis, Iron Mountain & Southern stock as collateral.

New York, New Haven & Hartford.—According to a press despatch from Newburg, N. Y., dated July 18, William Underhill, General Manager of the Newburg, Dutchess & Connecticut, has announced that negotiations have been concluded by which control of his road will soon pass to the N. Y., N. H. & H. The Newburg, Dutchess & Connecticut runs from Dutchess Junction, N. Y., on the Hudson division of the New York Central opposite Newburg, to a point on the Connecticut state line near Millerton, N. Y., 59 miles. It is capitalized at $500,000 common and $600,000 preferred stock. Its funded debt consists of $1,164,500 income 6 per cent. bonds of 1977, interest payable if earned, and $26,000 collateral trust 5 per cent. bonds of 1921. The New Haven road has been paying for trackage rights over the N. D. & C. between Wicopee and Hopewell Junction, 14 miles, as part of its freight line from Fishkill, N. Y., east into Connecticut.

Philadelphia & Reading.—This road has announced that it will purchase at maturity the $1,500,000 first and $300,000 second mortgage bonds of the Delaware & Bound Brook, which mature on August 1. Holders who presented their bonds before July 16 had the option, upon the payment of a premium of 1 per cent., of exchanging their bonds at par for a new issue of $1,800,000 first mortgage consolidated 3½ per cent. gold bonds of 1955 of the Delaware & Bound Brook.

Pittsburg, Binghamton & Eastern.—E. H. Gay & Co., of New York, are at the head of a syndicate which has bought $4,000,000 50-year 5 per cent. gold bonds and an equal amount of preferred stock, which will provide about $6,000,000 for building this road. The P., B. & E. is to run from Binghamton, N. Y., to Ansonia, Pa., on the Buffalo, Rochester & Pittsburg, 143 miles. The authorized bond issue is $10,000,000, of which not more than $5,000,000 including the present issue may be used for construction. The other $5,000,000 bonds may be issued only on additional mileage. The company has authorized issues of $5,000,000 common and $5,000,000 preferred stock.

Rio Grande.—A controlling interest in the $255,200 capital stock of this road has been purchased by the Yoakum-Frisco interests at a price said to be $30 per share. This is a narrow gage road 22 miles long, and runs from Brownsville, Tex., to Point Ysabel.

Tidewater & Western.—This company, the successor of the Farmville & Powhatan, recently sold at foreclosure, has been incorporated in Virginia with $500,000 authorized capital stock. It owns 89 miles of narrow gage line from Farmville, Va., to Bermuda Hundred, and its charter permits the building of branches not over 50 miles long from its line in any direction, and also the extension of its main line to the Virginia, Tennessee and Kentucky boundaries.

Vandalia.—The Vandalia Coal Company has been incorporated as an ally of the Vandalia Railroad to own 22,000 acres of coal lands and 27 operating plants in Indiana, and operate 9,000 acres of undeveloped coal lands under lease. The company has $2,000,000 common stock, $2,000,000 6 per cent. cumulative preferred stock and $3,000,000 first mortgage 6 per cent. gold bonds of 1930 authorized. The bonds are a first lien on 19,000 acres of coal land. It is proposed to issue at once $781,000 common stock, $1,562,000 preferred stock and $2,500,000 bonds.

A protective committee representing the holders of the first mortgage bonds of the Terre Haute & Peoria, formed in 1896, has reported that it has succeeded in obtaining a favorable court decree and that as a result of its efforts all coupons to and including March 1, 1905, have in the meantime been paid. In addition, it has been effected that the Vandalia Railroad, a much stronger corporation than the Terre Haute & Indianapolis, the original lessee, now guarantees the bonds. The Terre Haute & Peoria was leased to the Terre Haute & Indianapolis and its bonds guaranteed by that company in 1892. On default, the Terre Haute & Indianapolis was placed in the hands of a receiver. The litigation over the validity of the lease and the guarantee of the bonds of the Terre Haute & Peoria by the Terre Haute & Indianapolis has been going on for nine years. The Terre Haute & Indianapolis has recently been merged into the Vandalia Railroad Company and the latter company by a decree of the court has been required to comply with all provisions of the original lease, making the Vandalia the guarantor of the principal and interest of the $2,500,000 bonds.

Western Maryland.—In connection with the reported purchase of the railroad and coal properties of the Little Kanawha syndicate by the Vanderbilt and Pennsylvania interests, through an option held by Colonel J. M. Schoonmaker, Vice-President and General Manager of the Pittsburg & Lake Erie, F. S. Longstreet, Vice-President of the Western Maryland, is quoted as follows in a Baltimore despatch, dated July 18: "No matter what may be the final outcome of the negotiations which have been going on in regard to the disposition of the Little Kanawha syndicate, our plans will not be in the slightest degree affected. Our original plans contemplated an extension of the Western Maryland system to connect with the Wabash lines at Pittsburg. They were not confined to any particular route, nor did they contemplate making any particular properties auxiliary feeders, and the Little Kanawha syndicate is not essential to us in making our connections as we have planned them."